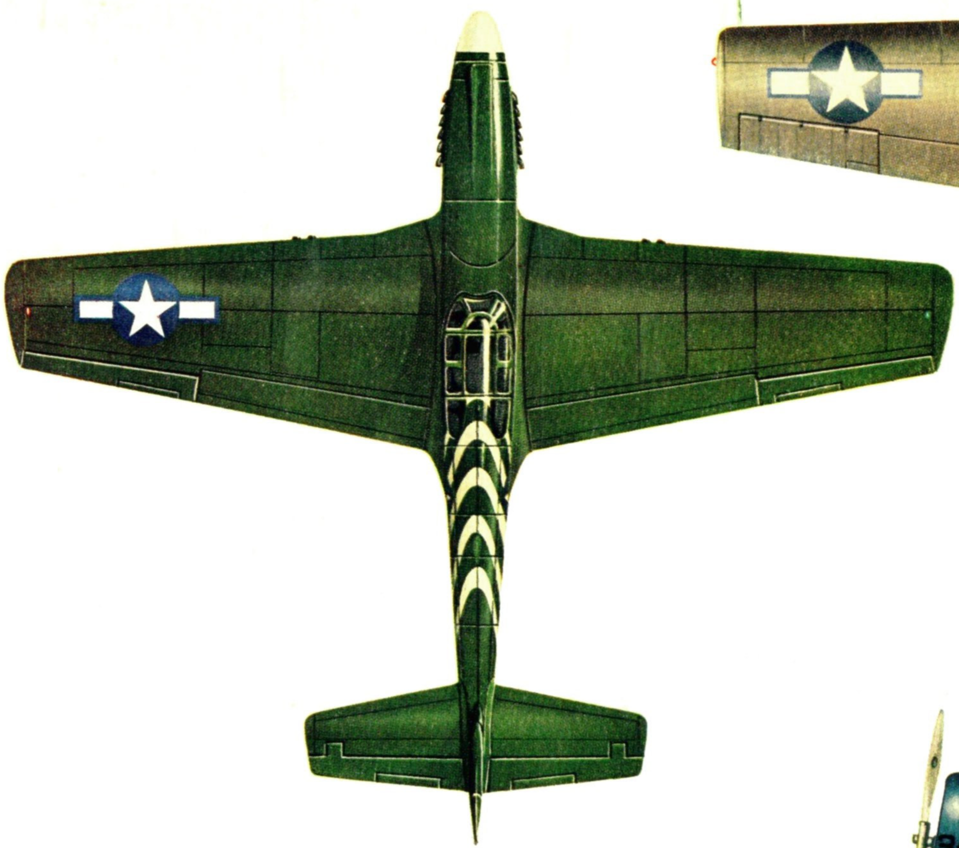
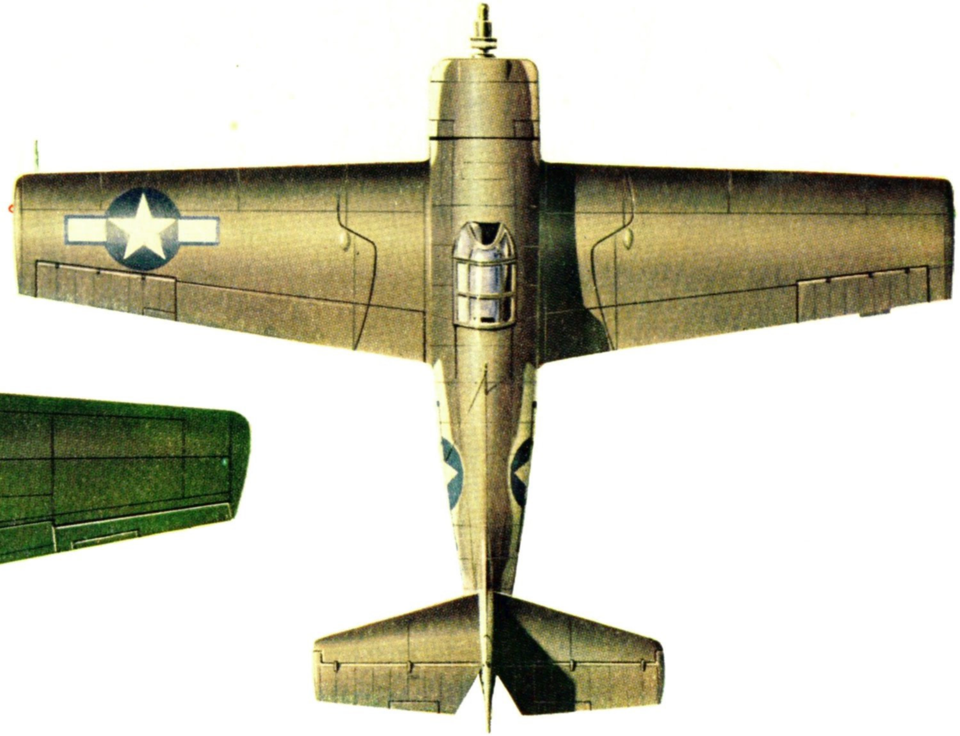
Men&Machines

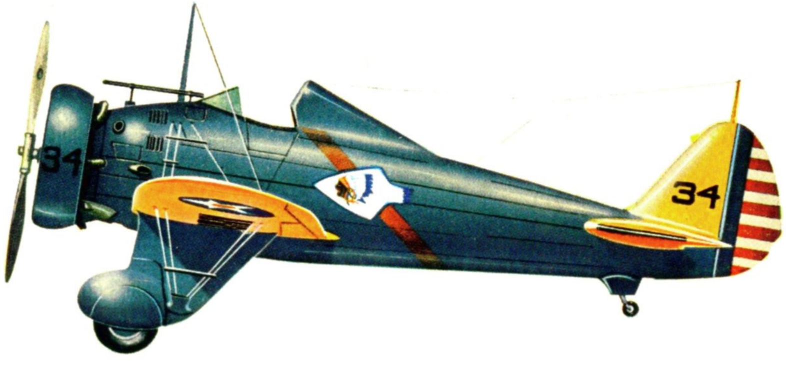
American Fighters

Of World War Two

Volume one







American Fighters

Of World War Two

Volume One

by Dr. Renè J. Francillon

illustrations by Kenneth Rush John Young Terence Hadler
Desmond Nicholas Harold Jacks Arthur Wolstenholme M. J. Doughty

Hylton Lacy Publishers Limited, Coburg House,
Sheet Street, Windsor, Berkshire, England

© Hylton Lacy Publishers Limited, 1968
© Kenneth Rush, 1968
© John Young, 1968
© Harold Jacks, 1968
© M. J. Doughty, 1968

Series Editor. C. W. Cain

First published in England, 1968,
by Hylton Lacy Publishers Limited,
Coburg House, Sheet Street, Windsor,
Berks, England

Available in the same series

German Air Force Fighters	Volume I
Royal Air Force Bombers	Volume I
German Air Force Bombers	Volume I
Royal Air Force Bombers	Volume II
Japanese Navy Bombers	
German Air Force Fighters	Volume II
Royal Air Force Fighters	Volume I
American Fighters	Volume II
German Air Force Bombers	Volume II

Second Edition 1971
SBN 85064 050 4

Printed in England by Mears Caldwell Hacker Limited, London

Foreword

When war cast its mantle of hatred and destruction over Europe for the second time in a generation in the fall of 1939, the American Fighter was an inferior weapon when compared to its contemporaries in other countries.

Twenty-three months later, when the Japanese attack on Pearl Harbour catapulted the United States into the holocaust, the situation had not altered to any significant degree. Among the types still in service, albeit in very small numbers, was the braced and spatted Boeing P-26, a beautifully proportioned machine that would have been practically defenceless against the formidable Mitsubishi Zero.

One year after the last P-26 was delivered to the Army Air Corps the Bell Aircraft Corporation submitted the designs of a modern, single-seat, low-wing, monoplane fighter—the P-39 Airacobra. This revolutionary machine introduced such novelties as the tri-cycle undercarriage and rear-mounted engine, and the world's first JATO unit, a liquid fuel rocket engine to boost climbing speed.

As originally conceived the Airacobra would have been more than a match for the aircraft it was to meet five years later, for its in-line, liquid-cooled Allison engine, boosted by a turbo-supercharger for altitude performance, pushed the machine along at an unprecedented 390 miles per hour at 20,000 feet. When considering the Messerschmitt Bf 109E's 353 miles per hour at the same height, students of aviation may well shake their heads at the decision at a later date to build production P-39s without the supercharger. As one pilot put it: "Without this installation, the P-39 was an excellent aircraft for flying in wide, low and slow circles."

But fortunately for democracy the American aircraft industry learned fast and well, and a number of inspired designs emerged within months after America's entry into the war.

The best known of these without any doubt is the Mustang, fighter supreme, admired and respected by fliers in both the Allied and enemy air forces. Here was the classic example of two brilliant designs, the airframe and the engine mated to produce a fighter which was to sweep all before it in all war theatres.

Finally, two other fighters are worthy of mention if only for their unorthodox design features. The P-38 Lightning with its twin booms, twin engines and powerful and concentrated armament seemed assured of success, but over Europe it was just another fighter. In the Pacific, however, the aircraft came into its element, and against the Japanese it was an unqualified success. It had the range, firepower and speed to take on and defeat anything that flew against it.

The second of America's twin boomed aircraft was the huge Black Widow, a specialized machine intended primarily as a night-fighter and which entered service late in the war. It was one of the few aircraft produced during the years 1939 to 1945 which served as an interceptor, and was never modified for the ground-attack rôle that seemed to be the fate of many of the fighters of its day.

California, 1968 René Francillon

Contents

Bell P-39 Airacobra 5
Boeing P-26 14
Grumman F4F Wildcat 18
Grumman F4F Hellcat 28
Lockheed P-38 Lightning 37
North American P-51 Mustang 49
Northrop P-61 Black Widow 60

Colour Illustrations

Bell P-39-1 Airacobra 8
FM-1 Wildcat 9
Boeing P-26A 10
Grumman F6F-3 Hellcat 23
Grumman F6F-5 Hellcat 24
P-38F-5 25/26
Lockheed P-38L-5LO 39/40
North American P-51A-1-NA 41
North American P-51B-15 Mustang 42
North American F-6K-10-NT 55
North American P-51D-20 Mustang 56
Northrop P-61A-5-NO 57/58

Bell P-39 Airacobra

The development of a new aircraft always results in a conflict between aerodynamic, stress, weight and power plant engineers struggling to achieve the best compromise between the conflicting requirements of their respective sciences. Unfortunately as soon as a compromise is reached the customers change their requirements, usually to add an item of equipment which will adversely affect the carefully-calculated balance.

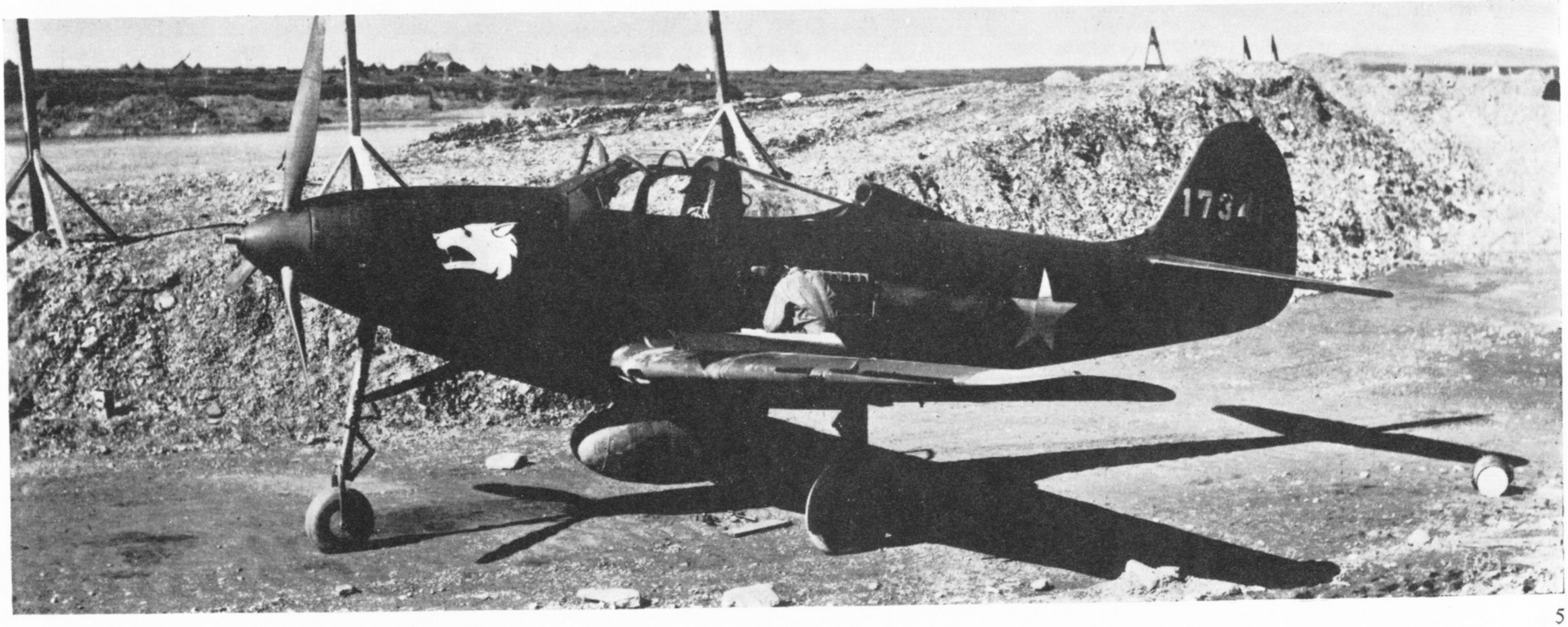
Perhaps one of the most striking examples of such an unfortunate situation is the Bell P-39 which, initially conceived as a fast-climbing interceptor powered by a turbo-supercharged engine (a liquid-fuel rocket engine was even proposed at one time by the manufacturers to boost climbing speed), was found in combat to possess especially disappointing 'low ceiling and slow rate of climb'.

Design history

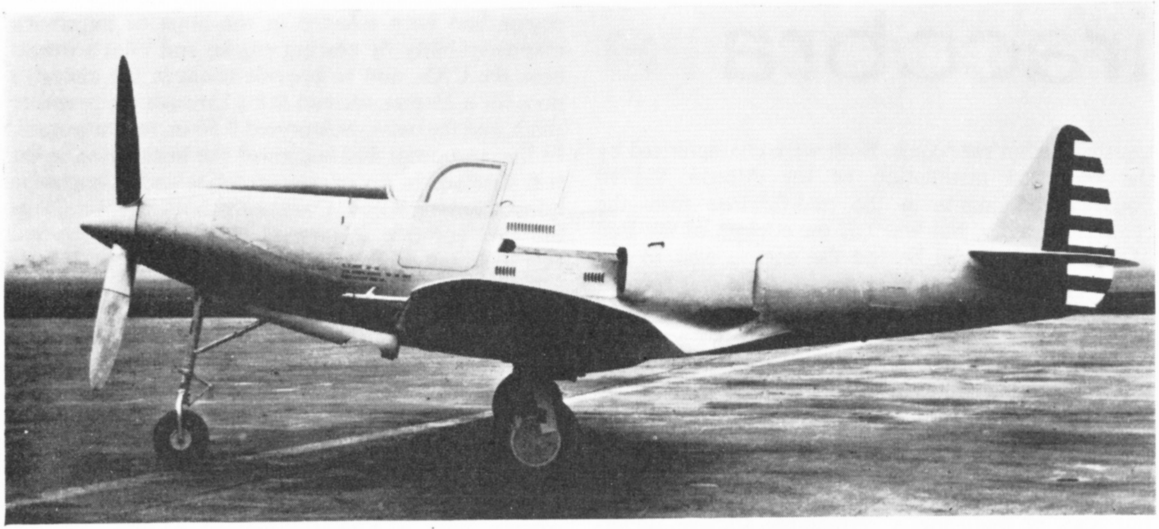
In answer to an invitation to bid, issued on March 19 1937 by the Army Air Corps, the Bell Aircraft Corporation submitted, within two months, two highly unusual design proposals. Both were characterised by the proposed installation of the Allison V-1710 liquid-cooled engine in the mid-fuselage near the centre of gravity, but whereas the cockpit of the Bell Model 3 was placed behind the engine well to the rear of the fuselage that of the Model 4 was located ahead of the engine. In both proposals the gear reduction box for the three-blade propeller was connected to the engine by a 10-ft. extension shaft.

As forward visibility would have been particularly poor from the cockpit of the Model 3, Bell concentrated their effort on the Model 4, after having completed a full-scale mock-up of the Model 3. The Bell Model 4 was unusual not only in its engine location but also in featuring a retractable tricycle undercarriage, and in having automobile-type entrance doors on both sides of the cockpit instead of the more conventional sliding canopy. The location of the engine had been selected in the hope of improving manœuvrability by placing engine and pilot's weight near the C.G., and to provide room in the aircraft's nose for a 25-mm. cannon firing through the propeller shaft, and for two synchronised 0.50-in. machine-guns. In their proposal Bell suggested the installation in the rear fuselage of an oxygen–gasoline rocket engine to boost climbing speed. Eventually the Army Air Corps did not approve this novel feature and instructed Bell to install an Allison V-1710-E4 (V-1710-37) with a B-5 turbo-supercharger.

In this form the aircraft was awarded, on October 7 1937, a prototype contract covering one aircraft, designated XP-39 by the Army Air Corps. By March 1939, when the aircraft (serial 38-326) was completed, several changes, dictated by results of wind-tunnel test and Air Corps change orders, had been incorporated, and armament—although not installed—had been modified by replacing the hub-firing 25-mm. cannon with a similarly located 37-mm. weapon. Trucked in great secrecy to Wright Field, Ohio, the XP-39 made its first flight on April 6 1939, with James Taylor at the controls. During trials the XP-39 reached at top speed of 390 m.p.h. at 20,000 ft., but severe cooling problems were experienced, and, as a temporary measure, the oil-cooler scoops on the sides of the fuselage were enlarged. Yet flight test results



P-39F of the 57th Fighter Squadron, 54th Fighter Group, on an airstrip on Kodiak Island in the summer of 1942. This aircraft, 41-7341, was one of 229 Fs constructed. [*U.S.A.F., via Francillon.*



The prototype XP-39 (38-326) at the time of its first flight on April 6 1939, from Wright Field, Ohio. [*Bell, via Francillon.*

were sufficiently promising to warrant the placing by the Army Air Corps of a contract covering twelve YP-39s and one YP-39A. It was initially intended that the YP-39s would be identical to the XP-39, with the exception of minor equipment changes, whilst the YP-39A was to be powered by a high-altitude V-1710-31 without turbo-supercharger. Further tests with the XP-39 revealed the need to substantially modify the aircraft and the contract covering the thirteen experimental ships was modified accordingly.

Following completion of the first test phase with the XP-39, and a series of experiments conducted by the N.A.C.A., the aircraft was extensively modified by Bell. Designated XP-39B the modified prototype was now powered by a V-1710-37 without turbo-supercharger, thus compromising the operational future of the aircraft, but, admittedly, simplifying manufacturing and maintenance. Externally the aircraft was characterised by the re-location of the oil-cooler intakes from the sides of the fuselage to the wing roots, the addition of a carburettor intake behind a lower canopy and the installation of covers over the main wheels. Even though maximum speed was reduced to 375 m.p.h. at 15,000 ft. the Army Air Corps was satisfied by the results of the modification programme, and instructed Bell to complete the thirteen YP-articles (serials 40-027 to 40-039) to this standard. These YP-39s, designated Model 12 by their manufacturers, mounted two additional 0.30-in. machine-guns in the nose.

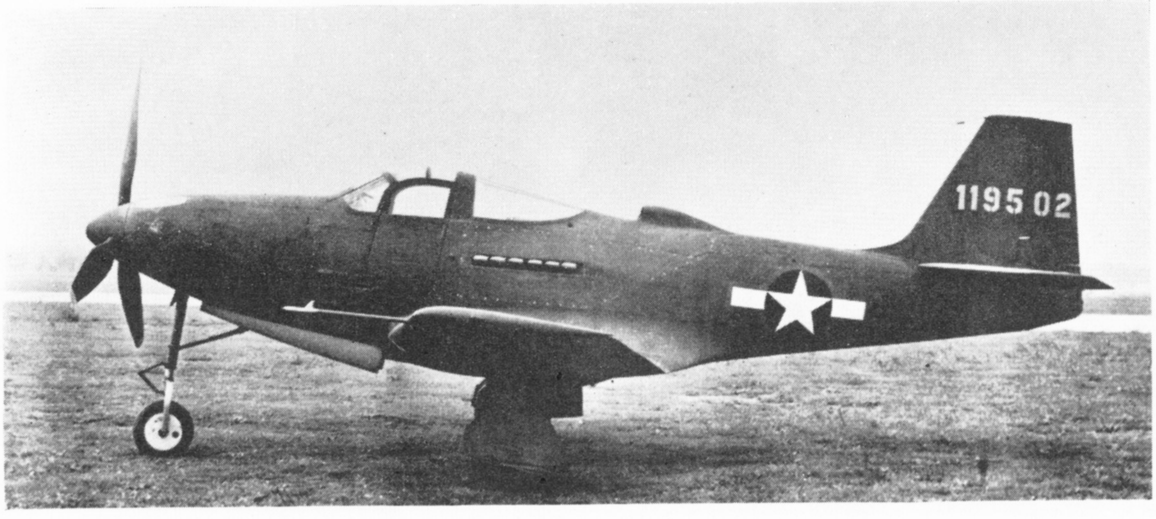
Already, on October 12 1939, some eleven months before the completion of the first YP-39, Bell had received a production contract for eighty P-45s which were to be similar to the YP-39 but powered by a V-1710-35, whilst on May 8 1940 the British Purchasing Commission ordered 675 aircraft which were originally named Caribou and later named Airacobra. The change of designation from P-39 to P-45, which reflected the substantial changes introduced since the submission of the original XP-39 proposal, was cancelled, as—for budgetry reasons—it was easier to obtain funds for development of an 'existing' type. Consequently, these eighty aircraft were delivered as P-39C and P-39D.

Airacobra development

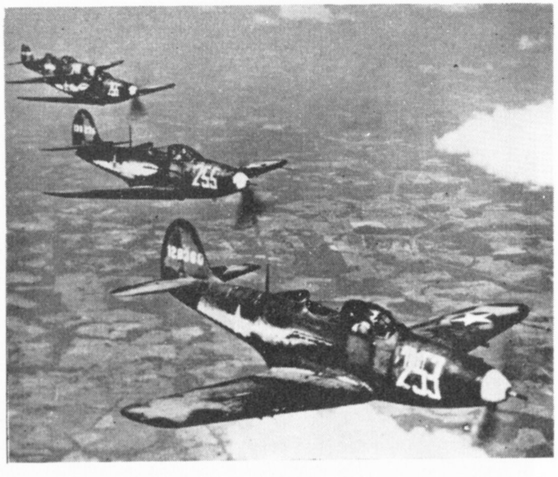
Once placed in production the P-39 underwent considerable development which may be traced through the following variants:

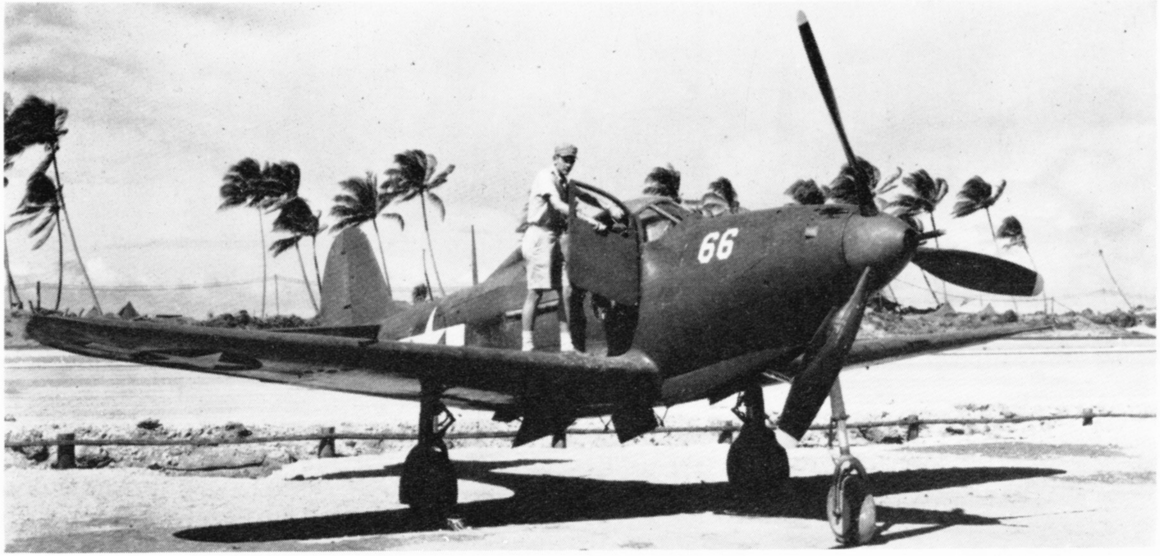
P-39C: First twenty aircraft from P-45 contract

The second experimental XP-39E (41-19502) with laminar flow wing and revised fin outline. Production of the P-76 (as it was designated) was cancelled after contract for 4,000 aircraft was awarded. [*Bell, via Francillon.*



Formation of four P-39-D-1s of a training unit in America, April 1942. Lead aircraft (41-28360) was one of the first batch built in the 41-28257 to 41-28406 serial range. [*U.S.A.F., via Francillon.*





P-39K flown by Lt-Col Milton B. Adams in the Pacific theatre. [*U.S.A.F., via Francillon.*

(40-2971 to 40-2990). V-1710-35. One 37-mm. cannon in spinner plus two 0.30-in. and two 0.50-in. machine-guns in the nose. Went into service in the United States in the spring of 1941. No combat duty and later designated RP-39C in the 'Restricted' status category.

P-400: 179 Airacobras ordered by the British but repossessed by the Army Air Forces in December 1941. Retained their British camouflage and serial numbers. Combat duty in the South Pacific. V-1710-35. One 20-mm. cannon in the spinner, two 0.50-in. machine-guns and four wing-mounted 0.30-in. machine-guns (0.303-in. on aircraft delivered to the R.A.F.).

P-39D: Last sixty aircraft originally ordered as P-45C (40-2991 to 40-3050). Follow-on contrscts for 369 aircraft (41-6722 to 41-7052, 41-7057 and 41-7058, and 41-7080 to 41-7115). V-1710-35. One 37-mm. in spinner, two 0.50-in. machine-guns and four wing-mounted 0.30-in. machine-guns. Small dorsal fillet added at the base of the fin. First 'combat-ready' variant of the Airacobra fitted with self-sealing petrol-tanks and armour protection. Reduction in internal petrol-tank capacity from 170 to 120 U.S. gallons offset by provision for a 75-gallon ventral drop-tank. This was the first model of the P-39 to go into combat and as such deserved some attention. Addition of military equipment and fitting of self-sealing tanks and armour increased weight substantially, whilst substitution of a V-1710 variant without turbo-supercharger for the V-1710-37 of the XP-39 seriously affected the performance. For comparison purposes increase in weights and changes in performance are given for the XP-39 and P-39D and for the XP-40 and P-40E.

	XP-39 vs P-39D	XP-40 vs P-40E
Empty weight:	+36.7%	+17.2%
Loaded weight:	+37.8%	+32.2%
Max. speed:	−5.6%	+5.8%

P-39D-1: First variant produced under Lend-Lease contracts. 336 built (41-28257 to 41-28406, 41-38220 to 41-38404 and 41-38563). V-1710-35 engine. One 20-mm. cannon in spinner, two fuselage-mounted 0.50-in. machine-guns and four wing-mounted 0.30-in. machine-guns.

P-39D-2: 158 aircraft (41-38405 to 41-38562) identical to P-39D-1 but powered by a V-1710-63. Provision for a 145 U.S. gallon flush-mounted ventral tank.

XP-39E: Experimental version fitted with a laminar flow wing which was to have been powered by a Continental IV-1430-1 engine. Three prototypes (41-19501, 41-19502 and 42-71464) eventually tested with Allison V-1710-47 and carrying same armament as P-39D. Shape and area of tail surfaces underwent several changes. Planned production under P-76 designation cancelled less than three months after award of a production contract for 4,000 aircraft.

P-39F: Identical to P-39D apart from replacement of Curtiss Electric propeller with an Aeroproducts unit of increased diameter (11 ft. 1 in. instead of 10 ft. 5 in.). 229 built (41-7116 to 41-7344).

P-39F-1: Two aircraft from above batch modified for photo-reconnaissance duty.

P-39F-2: Field modifications of P-39F to increase belly armour.

P-39G: 1,800 aircraft ordered but none delivered as P-39G. Contract transferred to P-39K, L, M and N.

P-39H and P-39I: Designations not assigned.

P-39J: Similar to P-39F but powered by V-1710-59. Only 25 built (41-7053 to 41-7056 and 41-7059 to 41-7079).

P-39K: First 210 aircraft (42-4244 to 42-4453) from P-39G. V-1710-63 with Aeroproducts propeller. Same armament as P-39D (37 mm. × 1, 0.50-in. × 2 and 0.30-in. × 4).

P-39L: As above but Curtiss Electric propeller. 250 built (42-4454 to 42-4703). Modified nose-wheel.

P-39M: 240 aircraft (42-4704 to 42-4943) with V-1710-83 and Curtiss propeller.

P-38N-O and -1: First large-scale production variant with 1,400 aircraft built (42-4944 to 42-4053, 42-8727 to 42-9726 and 42-18246 to 42-18545). V-1710-85 with Aeroproducts propeller. Same armament as P-39D. Internal fuel capacity reduced from 120 to 87 U.S. gallons.

P-39N-5: 695 aircraft (42-18546 to 42-19240) similar to P-39N-1 but with armour weight reduced from 231 to 193 lb. Curved armour plate behind the pilot supplanted the bullet-proof rear section of the canopy.

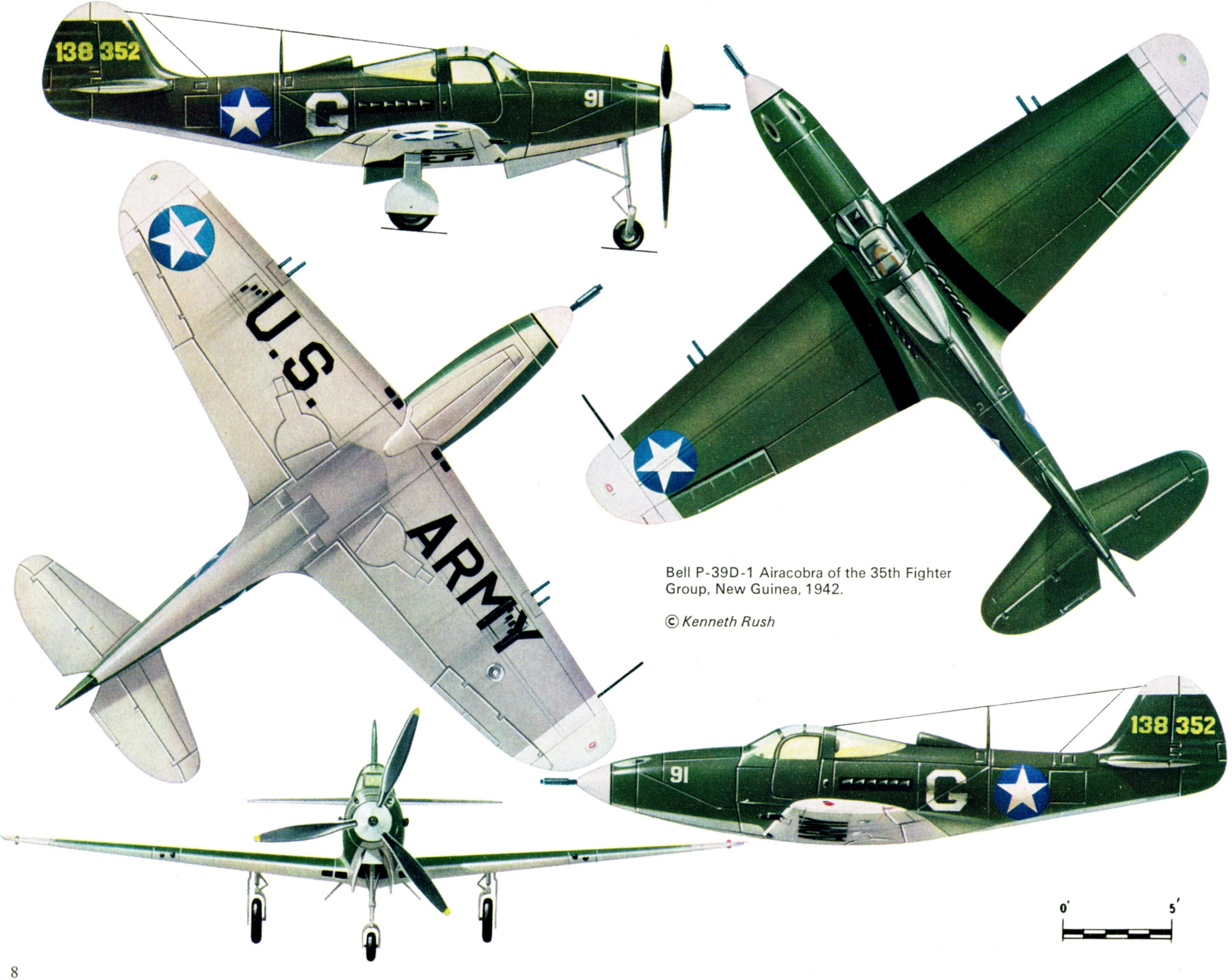
P-390 and P-39P: Designations not assigned.

P-390: Main production model powered by a V-1710-85 and armed with one 37-mm. cannon in the spinner, two engine-mounted 0.50-in. machine-guns and two 0.50-in. machine-guns mounted in external gondolas—one under each wing. A total of 4,905 P-39Q were delivered (42-19446 to 42-21250, 44-2001 to 44-4000, 44-32167 to 44-32666 and 44-70905 to 44-71504). Changes in internal fuel tankage, minor equipment changes and armour weight differentiated the Q-1, Q-5, Q-10, Q-15, Q-20 and Q-30 batches but all were fitted with three-bladed Aeroproducts propeller whilst the P-39Q-21 and P-39Q-25 were fitted with four-bladed Aeroproducts propeller.

TP-39: Two-seat trainer modification. Armament deleted and second seat added forward under extended canopy. Kits supplied by Bell for field modifications of aircraft from various P-39 series.

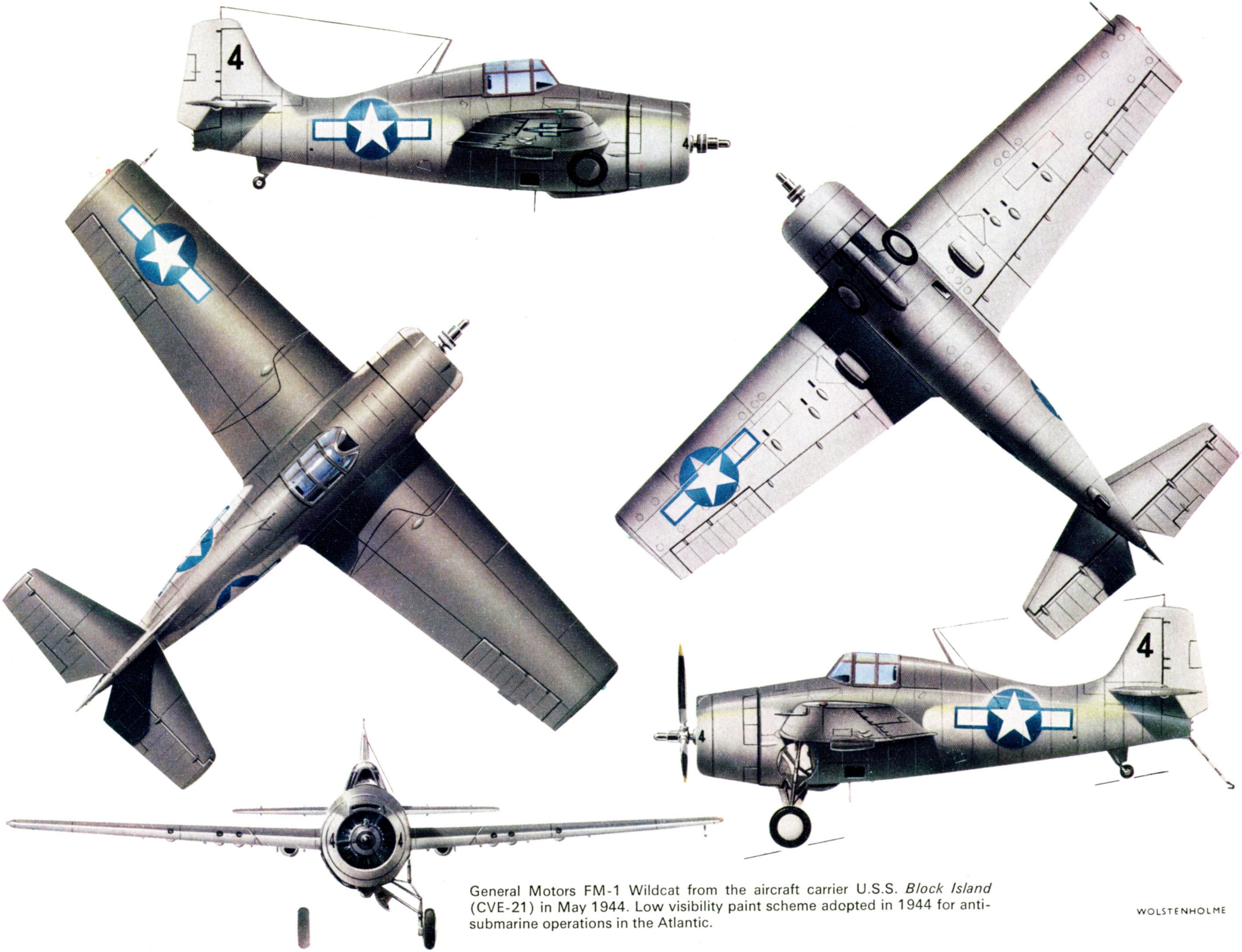
A-7: Projected radio-controlled target version of P-39. Not proceeded with.

F2L-1K: Two aircraft delivered in 1946 to U.S. Navy for use as target drones. P-39Q-5-BE (42-19976)


138 352
91
G
U.S.
ARMY
0'
5'

Bell P-39D-1 Airacobra of the 35th Fighter Group, New Guinea, 1942.

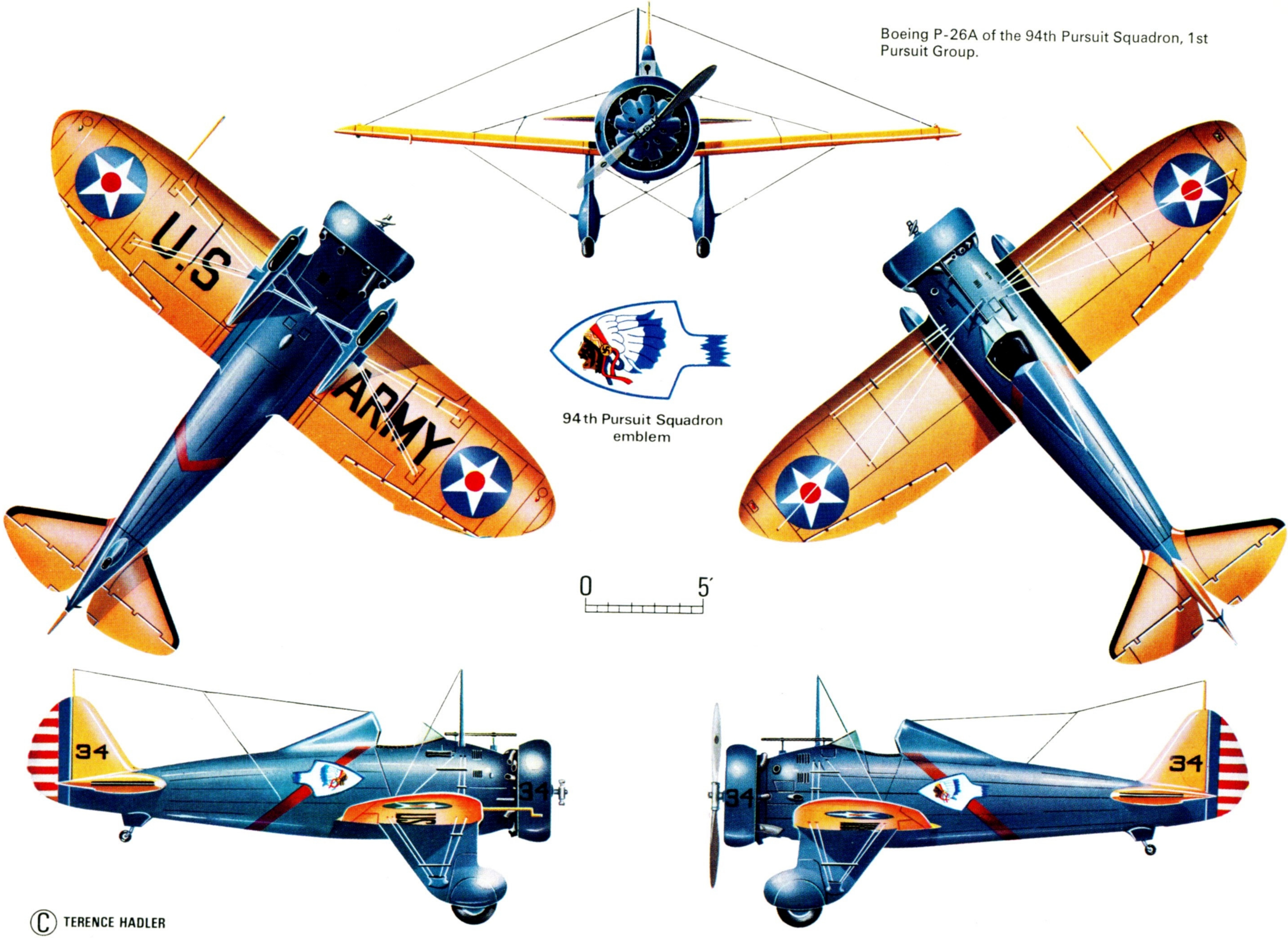
© *Kenneth Rush*



General Motors FM-1 Wildcat from the aircraft carrier U.S.S. *Block Island* (CVE-21) in May 1944. Low visibility paint scheme adopted in 1944 for anti-submarine operations in the Atlantic.

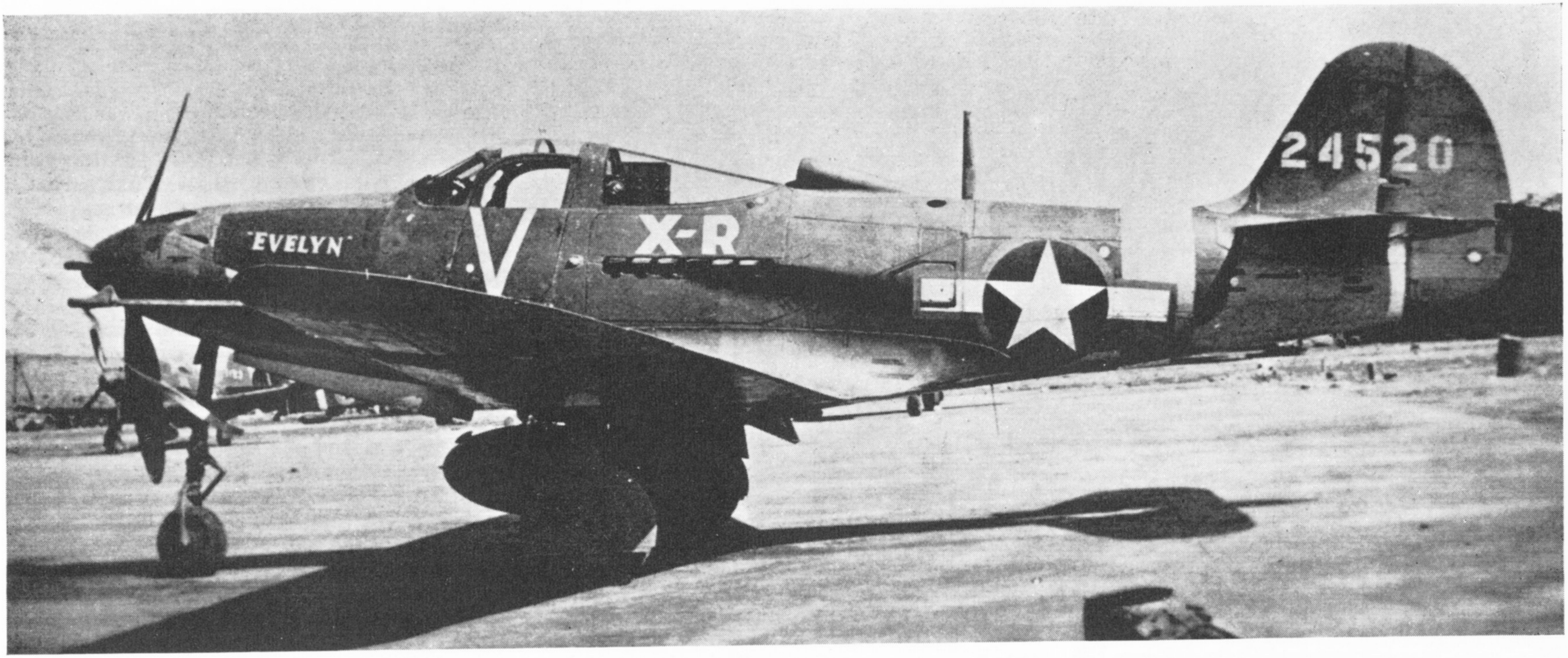
WOLSTENHOLME

Boeing P-26A of the 94th Pursuit Squadron, 1st Pursuit Group.


U.S
ARMY
0
5′
34
34

94th Pursuit Squadron emblem

© TERENCE HADLER



P-39K-1-BE (42-4520) 'Evelyn', photographed in North Africa in 1943. [*R. Baseler, via Francillon.*

became BuNo. 91102 and P-39Q-10-BE (42-20807) became BuNo. 91103.

In August 1944 the last Airacobra was completed, bringing total production to 9,589 aircraft (8,914 P-39s, 179 P-400s and 496 Airacobras for the R.A.F. and the Soviet Air Force). Of these more than half were delivered to the Soviet Air Force.

Service history

Deliveries of the P-39C began in January 1941 and a month later the 31st Pursuit Group at Selfridge Field, Michigan, became the first unit of the Army Air Corps to be equipped with Airacobras. Yet the P-39C could not be considered fully operational as it lacked self-sealing tanks and armour, and deliveries of 'combat-ready' P-39Ds began in April 1941.

When the war broke out the few available P-39Cs and Ds were deployed along the west coast of the United States in anticipation of a Japanese attack which never materialised. As more aircraft, including repossessed P-400s and P-39D-1s and D-2s, became available, units equipped with Airacobras were moved forward to bases in Alaska and in the Panama Canal Zone, whilst in March 1942 the 8th Pursuit Group became the first P-39 unit to be deployed overseas, when they were sent to Australia.

The arrival of the 8th Pursuit Group came at a ost opportune time, as since mounting a first airm raid against Port Moresby on February 3 1942, the Japanese kept putting pressure on this base, which was the last Allied stronghold protecting Australia. In early April 1942 the 8th Pursuit Group began detaching to Port Moresby a few pilots and aircraft to gain combat experience in the area, and two of these pilots scored the first Airacobra's hits on an enemy aircraft during a mission on April 6. However, these sporadic combats gave place to full combat operations beginning on April 30, when Lt-Col Boyd D. Wagner led in to Port Moresby 26 P-39Ds of the 35th and 36th Squadrons of the 8th Pursuit Group. In a month of extensive operations the pilots of the 8th Group claimed 40 enemy aircraft destroyed but they had almost lost as many aircraft (25 in combat, 8 in forced landings and 3 on the ground). The Airacobra had been blooded.

The next unit to join in the fight against the Japanese was the 35th Fighter Group, which relieved the 8th at Port Moresby. For a while the Allied traded bombing raids against Lae and Salamaua for Japanese attacks against Port Moresby, and the Airacobras acted alternatively as escort fighters and interceptors. Faced by the *élite* pilots of the Tainan Kokutai, the pilots of the 35th Fighter Group had a difficult time as their Airacobras were out-manœuvred by the Japanese Zeros. Yet their gallantry impressed even their adversaries and the P-39s contributed effectively to the holding actions conducted by the Allies.

In August the Allies took the offensive by landing on Guadalcanal and, again, the Airacobras were where the action was. Operating a motley collection of P-400s and P-39D-1s the 347th Fighter Group was flown to Guadalcanal on August 22 1942. There again the Airacobras proved disappointing as interceptors—the Army Air Forces were paying for the decision not to fit turbo-supercharged engine on the production P-39s—and the P-400 became known as 'a P-39 with a Zero on its tail'! However, the aircraft began to gain an enviable reputation as an efficient ground-attack, fighter and fighter-bomber.

The Airacobra inventory in the Pacific was slowly built-up in the following months and, in addition to

P-39N-5-BE of the 5th Air Force in the South Pacific. One of 695 aircraft in the serial batch 42-18546 to 42-19240. [*U.S.A.F., via Francillon.*

the three groups already mentioned, the 15th, 18th and 318th Fighter Group were assigned to this theatre of operations. However, the P-39 was never a popular aircraft with pilots of the Army Air Corps and, lacking the range performance so vital in the island-hopping campaign, the Airacobra was soon replaced in the Pacific-based unit (the last P-39 unit in this theatre was the 347th Fighter Group which, already operating one squadron of Lightnings in November 1942, fully converted to P-38s in August 1944).

On the American continent the only P-39 units to be flown in combat was the 34th Fighter Group, which operated against the Japanese in Alaska and the Aleutians between May 1942 and January 1943. The 32nd, 36th and 53rd Fighter Groups operating in the Panama Canal Zone were also equipped with Airacobras for a number of months, but in the continental U.S. the P-39s were used only by replacement training units and for forming and training fighter groups prior to deployment overseas with more modern aircraft.

Whereas P-39 operations in the Pacific, if not impressive, represented at least a useful contribution to air power during the critical months until sufficient numbers of P-38s, P-47s and P-51s could be made available, P-39 operations in Europe proved an abysmal failure. For a short time, commencing before America's entry into the war, the 342nd Composite Group flew a number of P-39s from Reykjavik in Iceland, but it was to the 31st Fighter Group—the first unit to have been equipped with P-39s—that came the doubtful honour to take the Airacobra into combat operations against the Luftwaffe. One mission in July 1942, during which six out of twelve aircraft were lost without scoring, was all it took to result in a hurried change to Spitfire Vs.

In the North Africa/Middle East area the P-39s were operated as fighter-bombers by the 81st and 350th Fighter Groups and by two squadrons of the 68th Reconnaissance Group. With adequate fighter cover the P-39s were successfully operated in this role, and one more unit, the 332nd Fighter Group, converted to the type. Finally, in late 1944, this last-mentioned Group released their last P-390s. The combat career of the Airacobras with the Army Air Forces has come to an end less than 32 months after they had first fired their guns in anger.

The Airacobra evaluated

'Disappointing . . . of no use for operations in the South-West Pacific Theatre, except in an emergency', . . . 'suited for wide, low and slow circles'. Such were some of the nicer comments bestowed upon the P-39 by pilots and historians of the Army Air Forces. Yet if the performances of the aircraft are analysed, it appears that the Airacobra may have been one of the most underestimated aircraft of the Second World War.

Obviously the Airacobra cannot be favourably compared to the Lightning, Thunderbolt or Mustang, but, in the dark days of 1942, neither the P-38, nor the P-47, nor the P-51 were available in sufficient numbers to the Army Air Corps. Henceforth the P-39 must be compared to the only other type of fighter available in large numbers, the P-40.

Most A.A.F. pilots held the opinion that the P-40 was superior to the P-39 on the following counts: 1, lighter wing loading, and 2, superior performance above 15,000 ft. Whilst it is recognised that performances and weights of an aircraft can substantially differ whether they are measured when the aircraft is fresh out of the assembly line or if it has accumulated a substantial number of flying hours under operational conditions, a comparison between two aircraft types can only be fair if the performances of both types are measured under identical conditions. Thus official A.A.F. performance test data offer a valid comparison.

219474
Little Rebel

P-39Q of the 347th Fighter Group just after touch-down on an airfield at Makin in the Gilbert Islands. 'Little Rebel' (42-19474) was one of 4,905 Qs constructed.

As can be seen the P-39 officially compared favourably with the P-40. Similarly, comparative trials between the P-39D and the P-40E arranged by the Australian Department of Air to provide a point of comparison with the Commonwealth CA-12 Boomerang, showed that the P-39D was faster and climbed faster than the P-40E at any altitudes between sea-level and 30,000 ft. (speed differences in favour of the P-39D ranged from a maximum of 45 m.p.h. at 15,000 ft. to a minimum of 20 m.p.h. at 20,000 ft., whilst at 30,000 ft. the P-39D reached 310 m.p.h. versus 275 m.p.h. for the P-40E). This can hardly be called a performance gap in favour of the Warhawk! Why, then, was the P-39 so disliked by most of its pilots? Rather than by technical difficulties the Airacobra was beset by psychological misgivings on the part of the average pilot, who disliked knowing that the heavy engine stood poised behind him ready to crush him in case of a belly-landing. This fear, though understandable, was not borne out by facts, as the P-39 proved to be an exceptionaly sturdy aircraft; yet, until the advent of the jets, few pilots ever got used to sitting ahead of the engine.

The Airacobra was also the victim of several flying accidents resulting from failure to recover from spin and from stalls just before touch-down. Indeed, trim adjustments were necessary to prevent unintentional spins, and stalls could easily occur during landing approach, but, with proper training, pilots were able to prevent both types of accidents and Bell demonstrated to the satisfaction of the Army Air Forces that their P-39 was not only safe but also possessed pleasant flight characteristics.

Finally, to the debit of the aircraft it must be stated that, particularly on early models, the mixed armament (cannon, 0.50 in. and 0.30-in. machine-guns) created both ballistic and maintenance problems. Also, the long extension shaft—which proved highly reliable (it is claimed that the V-1710 engine has a life twice as long on the P-39 as on the P-40)—vibrated and caused unnecessary fatigue and distraction for the pilots.

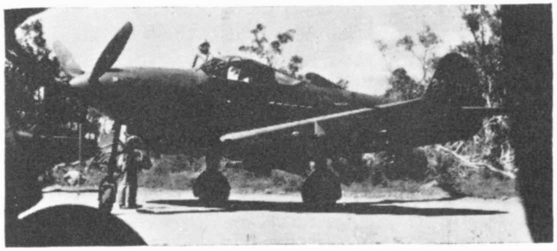
The Bell P-39 Airacobra was neither fast enough to be successfully used against Luftwaffe aircraft nor manœuvrable enough to counter the Japanese fighters, but it was strong and reliable and, last but not least, it was in the Army Air Forces' inventory when American badly needed fighter aircraft.

Comparison between the P-39 and the P-40

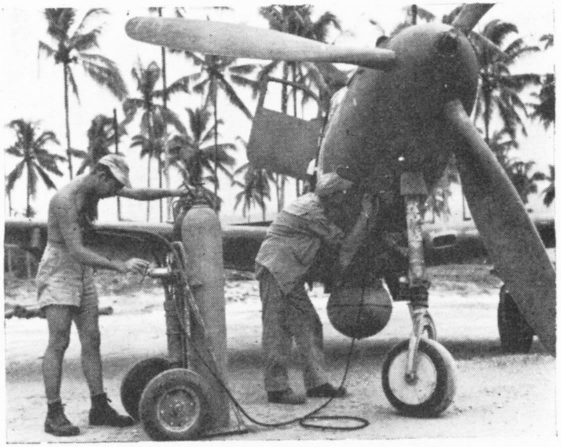
	P-39D	P-40E	P-39Q-5-BE	P-40N-15-CU
Empty weight, lb.	5,462	6,350	5,645	6,200
Loaded weight, lb.	7,650	8,280	7,600	8,350
Maximum weight, lb.	8,200	9,200	8,300	11,400
Wing area, sq. ft.	213	236	213	236
Wing loading, lb./sq. ft.	35.9	35.1	35.7	35.4
Maximum speed (m.p.h.) at 5,000 ft.	335	335	330	308
10,000 ft.	355	345	357	325
15,000 ft.	360	362	376	343
Climb to 5,000 ft., min.	1.9	—	2.0	—
10,000 ft., min.	3.9	4.8	4.0	4.7
20,000 ft., min.	9.1	11.5	8.5	8.8
Service ceiling, ft.	32,100	29,000	35,000	31,000
Engine, type	V-1710-35	V-1710-39	V-1710-85	V-1710-81
h.p. rating	1,150	1,150	1,325	1,200

	XP-39	YP-39	P-39D	XP-39E	P-39Q
Span, ft. in.	35 0	34 0	34 0	35 10	34 0
Length, ft. in.	28 8	30 2	30 2	31 11	30 2
Height, ft. in.	11 0	11 10	11 10	11 10	12 5
Wing area, sq. ft.	200	213	213	236	213
Empty weight, lb.	3,995	5,042	5,462	6,936	5,645
Loaded weight, lb.	5,550	7,000	7,500	8,918	7,700
Maximum weight, lb.	6,204	7,235	8,200	—	8,300
Wing loading, lb./sq. ft.	27.7	32.9	35.2	37.8	36.1
Power loading, lb./h.p.	4.8	6.4	6.8	6.7	5.4
Maximum speed, m.p.h./ft.	390/20,000	368/13,600	368/13,800	386/21,680	385/11,000
Cruise speed, m.p.h./ft.	—	257	213	205	200
Climb rate, ft./min.	20,000/5	20,000/7.3	15,000/5.7	20,000/9.3	15,000/4.5
Service ceiling, ft.	32,000	33,300	32,100	35,200	35,000
Normal range, miles	—	600	800	500	650
Maximum range, miles	—	1,000	1,545	800	1,250
Power plant	V-1710-17	V-1710-37	V-1710-35	V-1710-47	V-1710-85
T.O. rating, h.p.	1,150	1,100	1,100	1,325	1,200
Maximum rating, h.p./ft.	1,000/20,000	1,090/13,300	1,150/13,800	1,150/21,300	1,420/9,700
Armament	None fitted	1×37 mm. 2×0.50 in. 2×0.30 in.	1×37 mm. 2×0.50 in. 4×0.30 in. 500-lb. bomb	1×37 mm. 6×0.50 in. 500-lb. bomb	1×37 mm. 4×0.50 in. 500-lb. bomb

P-39Q on the airstrip at Cape Torokina, Bougainville, South Pacific, on December 12 1943. Legend on nose reads 'Vivienne of . . . .'



P-39Q-5 of the 13th Air Force on Tontouta Air Base, Noumea, New Caledonia. [*U.S.A.F., via Francillon.*



P-39Q of the 67th Fighter Squadron, 347th Fighter Group, complete with drop tank. [*U.S.A.F., via Francillon.*

Boeing P-26

On December 12 1915 the Junkers J-1 all-metal cantilevered monoplane made its first flight at Dessau, Germany. Intended as a research vehicle for demonstrating the potential of revolutionary design and construction principles, the J-1 led to a series of additional experimental aeroplanes which, late during the First World War, culminated in the quantity production of the Junkers J-9 single-seat fighter (41 built) and of the Junkers J-10 two-seat ground attack aircraft (43 built). Yet, despite its potential, the low-wing monoplane design was not adopted by the military services as it was felt that the monoplane structure would be too weak to withstand the stress of combat manœuvres.

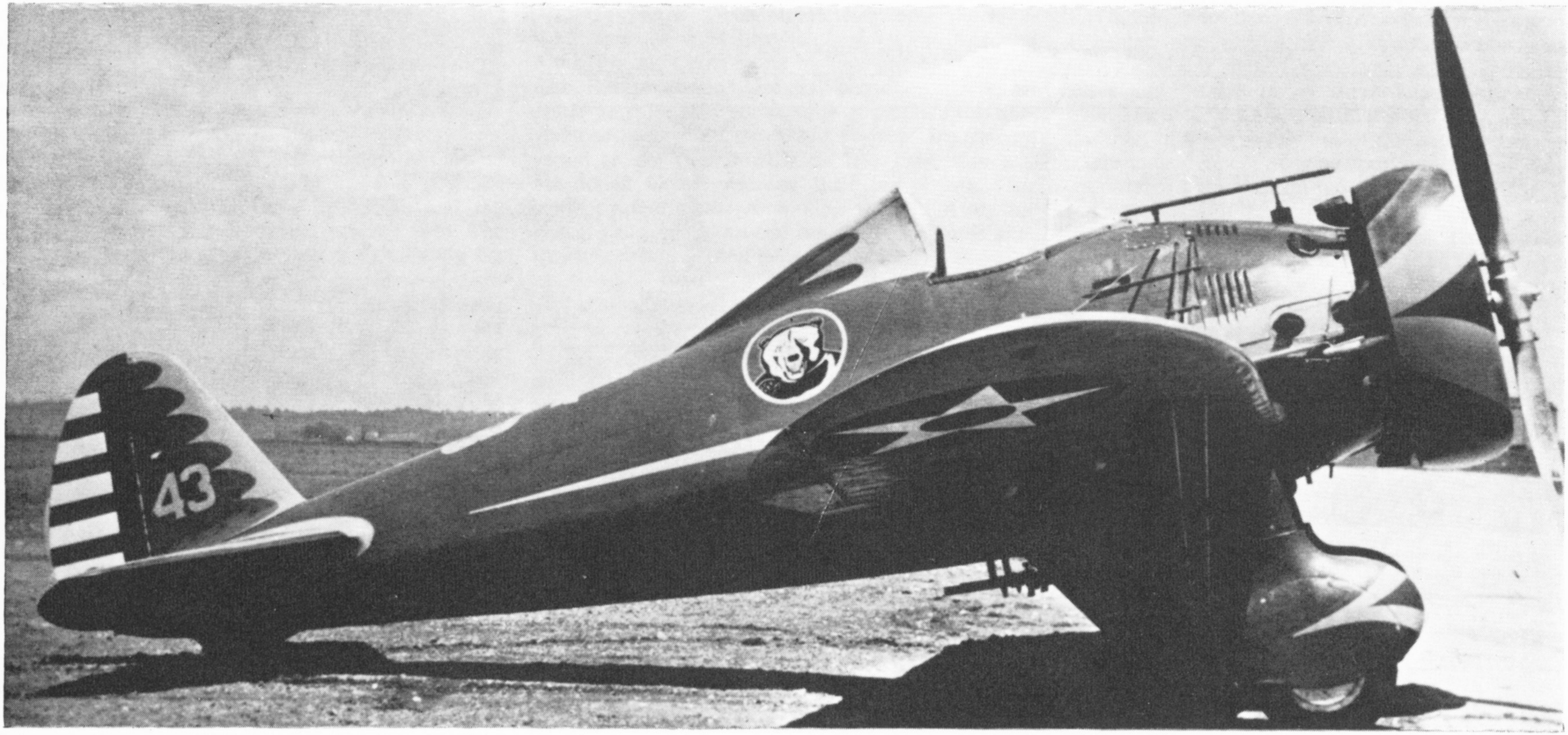
Thus, when on December 16 1933—just eighteen years after the first flight of the Junkers J-1—the 20th Pursuit Group at Barksdale Field, Louisiana, began to take delivery of their initial allotment of twenty Boeing P-26As (serials 33-29 to 33-48), a new trend was set. This time the all-metal low-wing monoplane was here to stay.

In the early thirties, following the 1929 stock-market crash and the economic depression which ensued, funds for development of new military aircraft were scarce and the manufacturers had to struggle to survive. It was under these unhappy circumstances that in September 1931 the Boeing Company and the Army Air Corps began discussing the requirements for a new pursuit aircraft. At that time the performances of bomber aircraft were surpassing those of fighter aircraft and the Martin XB-907, prototype of the B-10 series, was anticipated to be some twelve miles faster than the standard AAC pursuit aircraft, the Boeing P-12F. To restore the performance advantage of the pursuit ship over the bomber aircraft it became obvious that the manufacturers would have to depart from the conventional design still stemming from WWI concepts.

P-26A of the 73rd Pursuit Squadron, 1st Pursuit Group, fitted with bomb-racks under fuselage. [*Harry Gann, via Francillon.*

Thus Boeing had little difficulties in attracting the interest of the Army Air Corps with their proposal for a new all-metal, externally braced low-wing monoplane (manufacturers' designation: Model 248). Yet the financial hurdles remained as, despite their interest, the Army Air Corps were not in a position to purchase outright the Boeing aircraft. Consequently, on December 5 1931 Boeing were awarded an Army Bailment Contract providing for the construction of two flying prototypes and one structural test prototype. Under the clauses of this contract Boeing were to finance the construction of these aircraft, by then designated XP-926, and to retain titles to these machines whilst the Army Air Corps would supply Boeing with government-furnished equipment including instruments and engines.

On March 20 1932, only three and a half months



after the signature of the Army Bailment Contract, the first prototype made its first flight, whilst, shortly before, the second aircraft had been delivered to Wright Field, Ohio, where the Army Air Corps used it for static testing. Following highly successful manufacturer's trials, the first prototype, powered by a 525 h.p. Pratt & Whitney R-1340-21, was delivered to Wright Field for service trials.

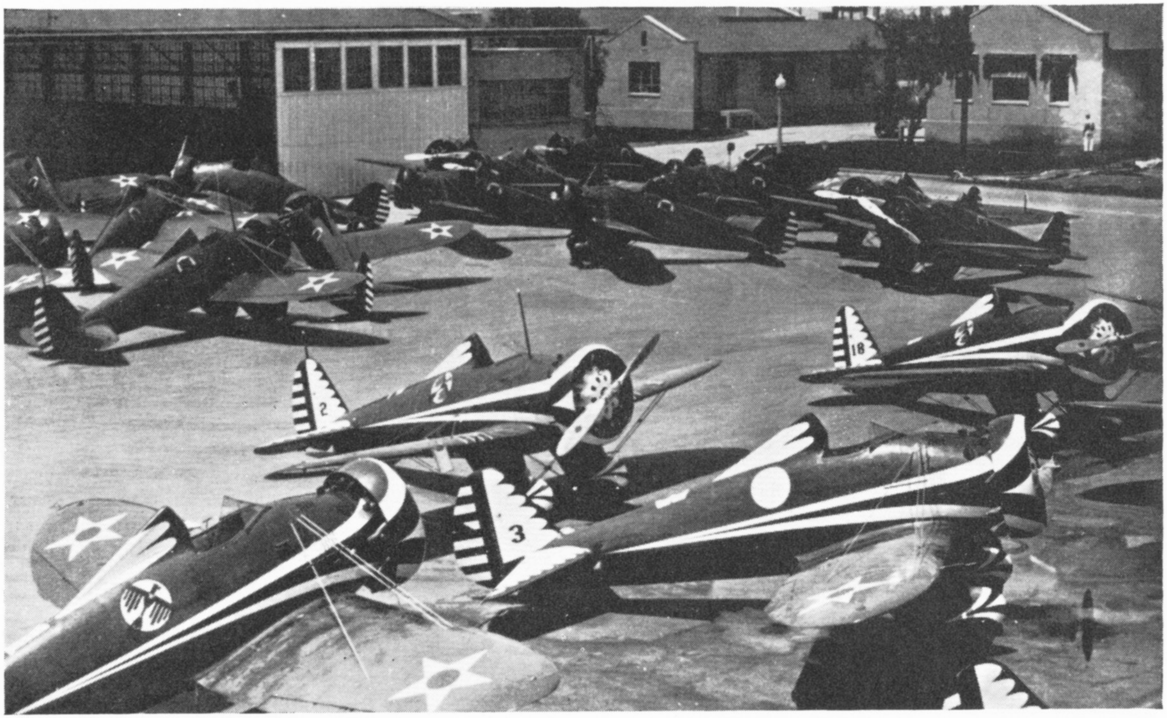
The confidence of the Army Air Corps—evidenced by the fact that the third prototype was delivered on April 25 1932 directly to Selfridge Field, Michigan, for testing under operational conditions—was fully rewarded, and the XP-926 was enthusiastically received by service test pilots. Boeing's speculative venture was then rewarded when on June 15 1932 the Army Air Corps purchased the three prototypes. Redesignated XP-26, these aircraft were assigned the serial numbers 32-412 to 32-414. Whilst tests with the two flying prototypes continued their designation was changed to reflect their new status and they became YIP-26 and finally P-26.

Into production

In answer to an Army Air Corps request Boeing incorporated into the design of the aircraft a number of minor modifications which had been found necessary, and had been included in a new specification issued on November 7 1932 and awaited a production contract. Finally, on January 11 1933, the Army Air Corps signed a contract covering 111 aircraft designated P-26A (33-28 to 33-138), the largest single contract awarded since 1921. The monoplane fighter was at last coming into being.

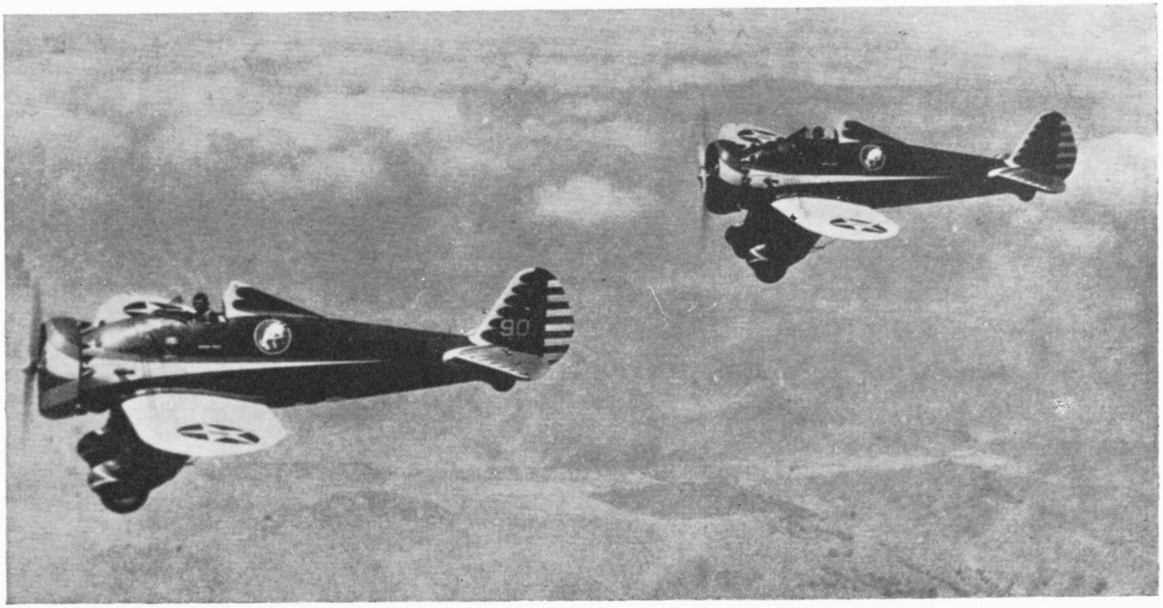
When first delivered in December 1933 the P-26As were externally identical to the prototype with the exception of a minor redesign of the wheel spats, but they incorporated a revised wing structure and new operational equipment, and were powered by 500 h.p. Pratt & Whitney R-1340-27. Initial allocation of aircraft produced in the first batch of 111 aircraft was as follows: serial 33-28 to Wright Field for additional service trials; serials 33-29 to 33-48 to the 20th Pursuit Group at Barksdale Field, Louisiana; serials 33-49 to 33-55, 33-58 to 33-76 and 33-78 to 107 to the 17th Pursuit Group at March Field, California; serials 33-56, 33-57 and 33-77 to the Bolling Field detachment for protection of Washington D.C.; and 33-108 to 33-138 to the 1st Pursuit Group at Selfridge Field, Michigan.

Whilst the P-26As began accumulating flight hours under operational conditions a number of modifications were found to be necessary. In its initial form the P-26A was fitted with a small head-rest behind the



Above: A group of P-26As at March Field, California. Aircraft in foreground belong to the 34th Attack Squadron, while those in background belong to 73rd Pursuit Squadron. [*U.S.A.F., via Francillon.*

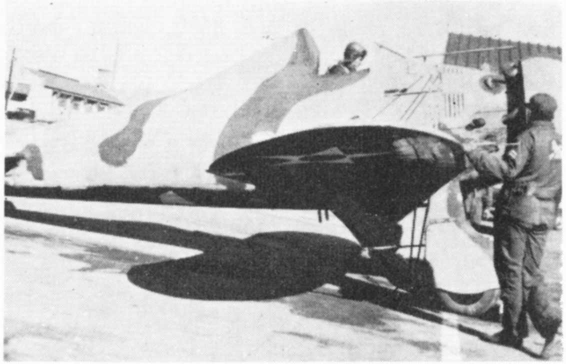
Below: Two P26As of the 95th Attack Squadron over southern California. Note 'Kicking Mule' insignia on fuselage. [*U.S.A.F., via Francillon.*



open pilot cockpit, but following a landing accident during which an aircraft overturned, killing its pilot, it was decided to fit a higher head-rest. This modification, incorporated on the production line, delayed for a while deliveries and was also incorporated on aircraft already delivered. The other major modification was initiated by the Army Air Corps, which, to lower the comparatively high landing speed of the P-26A, installed flaps on one aircraft. With these flaps landing speed was reduced from 82.5 m.p.h. to 74 m.p.h., but still exceeded that of the earlier Boeing P-12F, which landed at 59 m.p.h. This in fact was the only major criticism against the new monoplane fighter as it proved highly manœuvrable and its structural strength dispelled all previous doubts (one P-26A is known to have ended its career with 2,635 flying hours). The success of the experimental flap installation was such that Boeing were instructed to incorporate it on the aircraft still on the production line, and aircraft already in service were returned to Boeing to be retrofitted to the same standards.

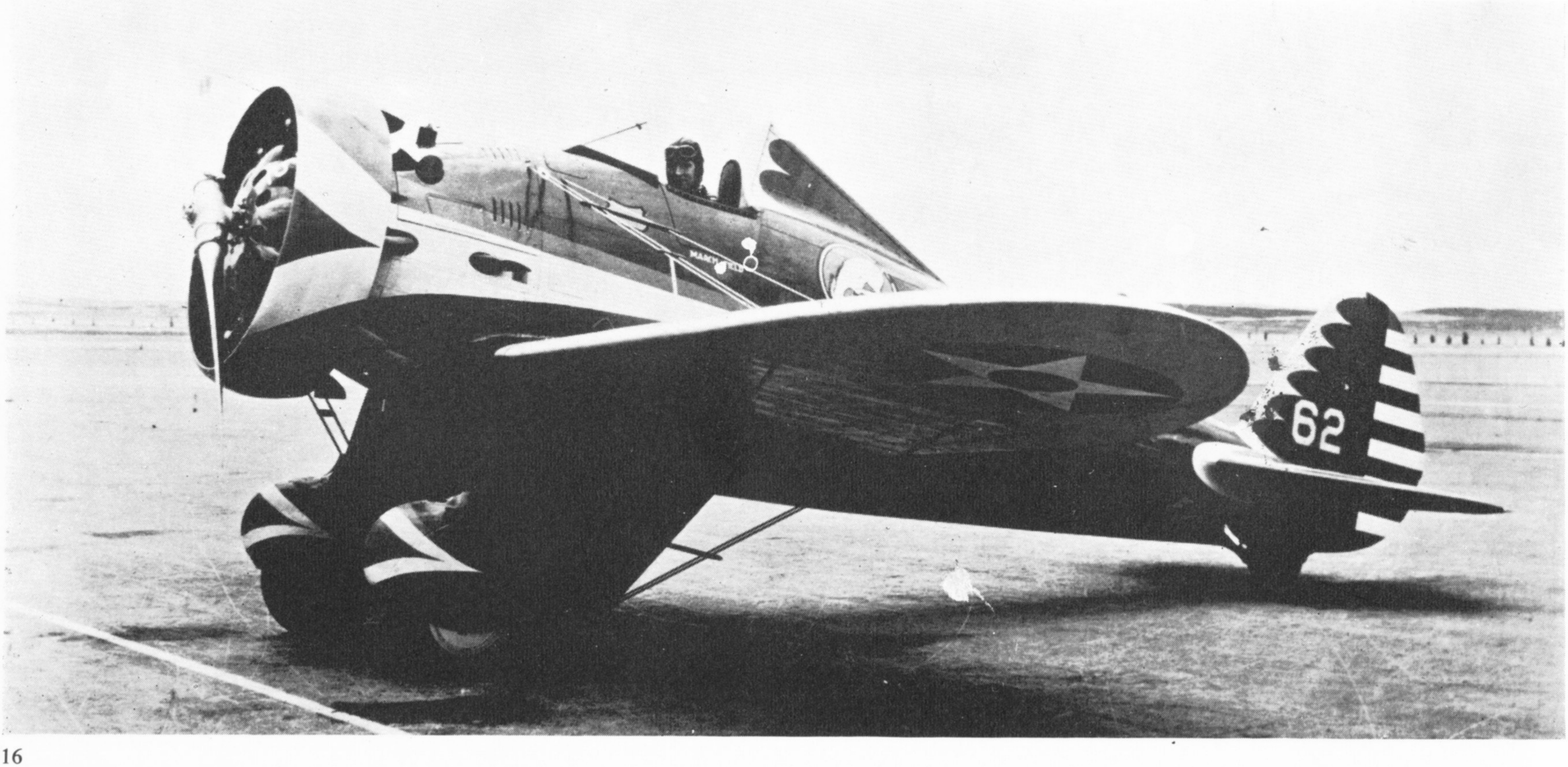
Despite the good results achieved in service with the P-26As only one repeat order was placed with Boeing as the Army Air Corps still operated under a very limited budget. This order covered twenty-five P-26Bs (33-179 to 33-203), which were to be powered by a fuel injection R-1340-33 rated at 600 h.p. and were to be fitted with a modified fuel and carburetion system. However, as insufficient numbers of R-1340-33 were available only two aircraft were delivered in P-26B configuration, whilst the remaining twenty-three aircraft were fitted with R-1340-27 and designated P-26Cs. Several of these P-26Cs were later brought to P-26B standards. All twenty-five aircraft from this contract were delivered to the 1st Pursuit Group at Selfridge Field, Michigan.

On March 7 1936 Boeing delivered the last P-26C, bringing total production to 151 aircraft, including 3 prototypes, 111 P-26As, 2 P-26Bs, 23 P-26Cs and 12 Boeing Model 281, the export version of the P-26. With its production ending the P-26 did not fade out, as the 'Peashooter', as the aircraft was affectionately known, remained in service until 1941. Of the three groups (the 1st, 17th and 20th) which had originally

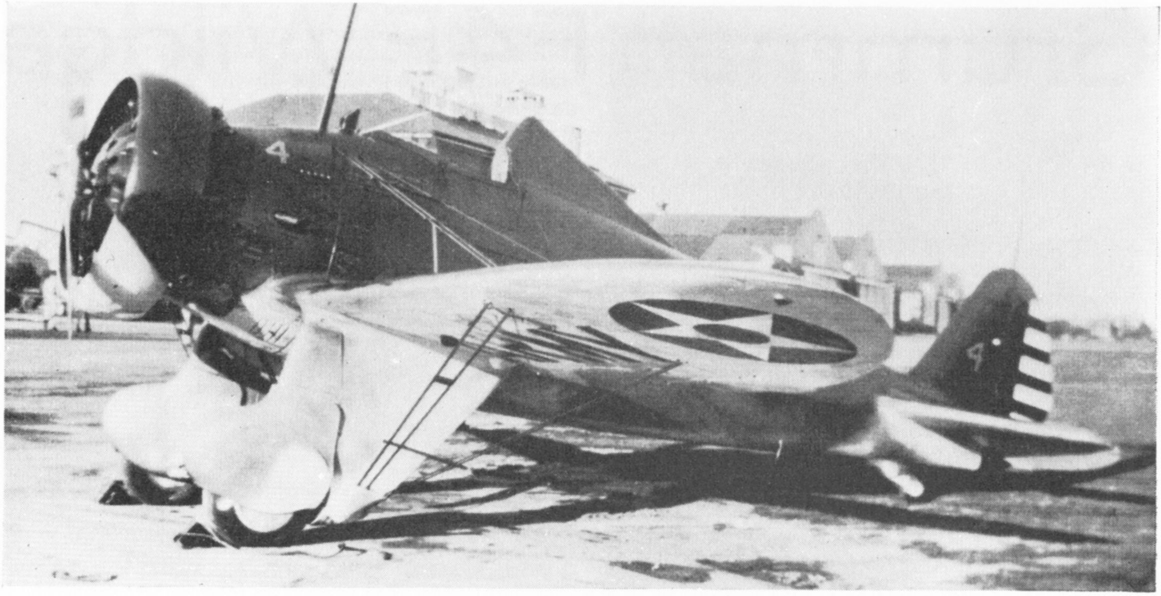


P-26A in experimental 'War Games' camouflage warming up its engine at March Field, California. The ground crewman wears the emblem of the 34th Pursuit Squadron on his back. [*via Francillon.*

P-26A of the 95th Pursuit Squadron, 17th Pursuit Group, at March Field, California, 1936. [*U.S.A.F., via Francillon.*



Another experimental camouflage scheme was carried by this P-26A, photographed at Selfridge Field, Michigan, in the late '30s. [*Harry Gann, via Francillon.*

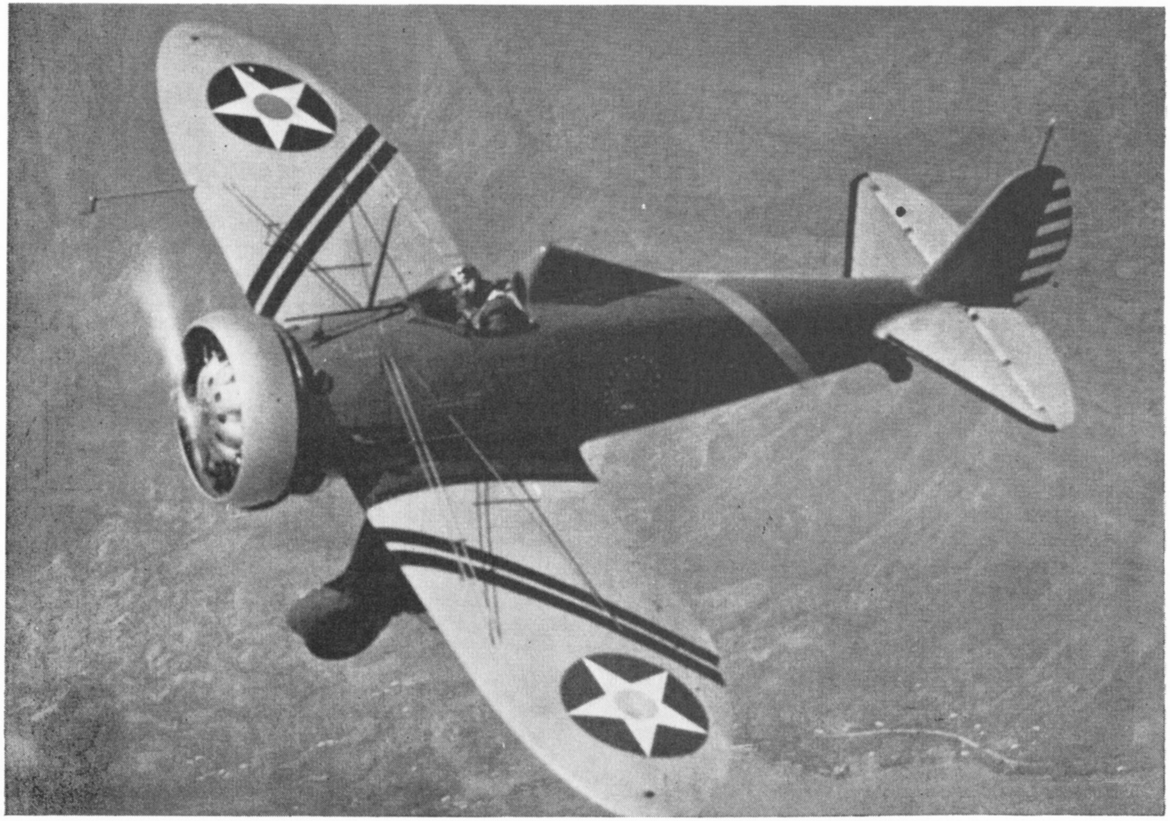


been assigned P-26As, the 20th were the last to trade their 'Peashooters' for more modern machines, doing so in late 1938. As the Seversky P-35s and Curtiss P-36s became available the P-26As, P-26Bs and P-26Cs were assigned to units operating outside the continental United States. In the Pacific both the 18th Pursuit Group, based at Wheeler Field, Hawaii, and the 3rd Pursuit Squadron of the Philippine-based 4th Composite Group flew aircraft of the P-26 series, whilst in the Panama Canal Zone the 16th, 32nd and 37th Pursuit Groups operated a number of P-26As. However, by the time the United States were drawn into the Second World War the P-26s were no longer in regular service, but a token number of aircraft were still on strength as communication and hack aircraft.

Never seeing combat operations with the Army Air Corps (although surplus P-26As of the Philippine Air Force and Model 281s of the Chinese Air Force did see limited action against the Japanese), the Boeing P-26 owes its place in history to the foresight of Boeing engineers, who succeeded in convincing the Army Air Corps that the low-wing monoplane design was indeed the fighter of the future. Yet, despite their company's experience with fully cantilever monoplane construction and with retractable undercarriage, they had to give in to deeply rooted concerns about such innovations. History might have been quite different if such features had been incorporated in the P-26 design (the Russians did introduce fully cantilevered monoplane construction and retractable undercarriage on their TsKB-12—the prototype of the Polikarpov I-16—which first flew a mere nine months after the XP-936).

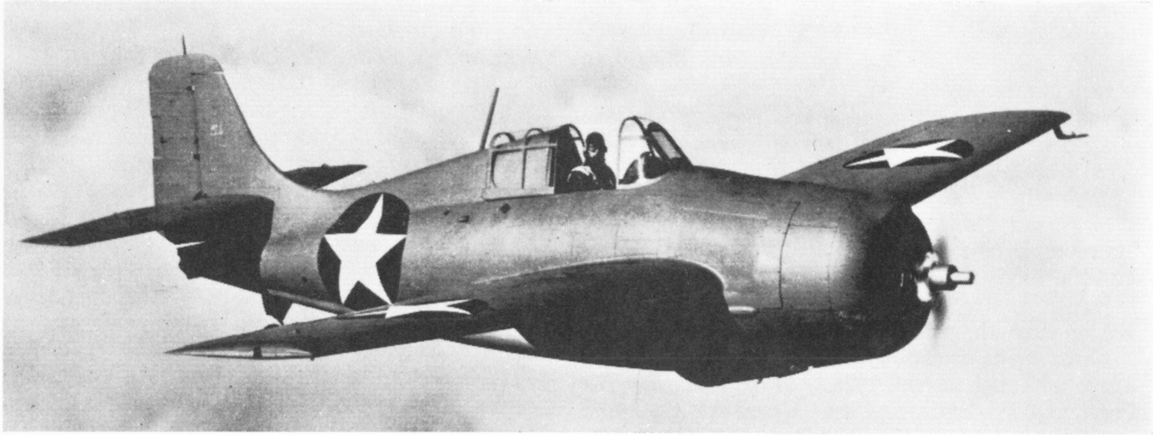
Specification

Boeing P-26: *span* 27 ft. 11½ in.; *length* 23 ft. 10 in.; *height* 10 ft. 5 in.; *wing area* 149.5 sq. ft.; *empty weight* 2,196 lb.; *loaded weight* 2,955 lb.; *max. bomb load* 3,012 lb; *max. speed* 234 m.p.h. at 6,000 ft. and 211 m.p.h. at sea-level; *cruise speed* 199 m.p.h.; climb to 6,000 ft. in three minutes; *service ceiling* 27,400 ft.; *range, normal* 360 miles; *range max.* 570 miles; *armament* two fuselage-mounted 0.30-in. m.g. One of the 0.30-in. m.g. could, optionally, be replaced by a 0.50-in. m.g. Five external racks under the fuselage and wings for either five 30-lb. or two 100-lb. bombs.



That the P-26 was a handsome machine is evident from this photograph of a 26B in flight over Hawaii. Note Flight Leader stripes on wings and fuselage of this 19th Pursuit Group Squadron aircraft. [*via Francillon.*

Grumman F4F Wildcat



Posing for the camera, a factory-fresh F4F-4. [*Grumman, via Francillon.*

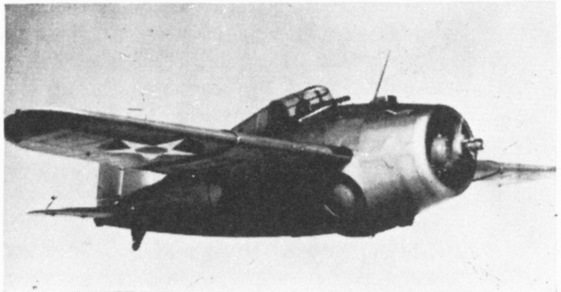
In the Wildcat the U.S. Navy possessed at the time of the Japanese attack against Pearl Harbour their only modern fighter aircraft. The Brewster F2A1, which initially had been selected for production over the Wildcat's prototype—the XF4F-2—just did not have the performances or armament required for combat operations, and the Wildcat's stablemates—the F2F and F3F biplanes—were hopelessly obsolete. Yet in its original version the aircraft had been rejected by the U.S. Navy and the type was saved from oblivion by its manufacturer's stubborn efforts to develop their aircraft into a satisfactory service type. In the process 22 months had elapsed between the initial design work on the F4F series in November 1935 and the first delivery of F4F-3s to U.S. Navy fighter squadrons.

At this point it is interesting to note that although the design of the Wildcat's major adversary, the Mitsubishi A6M Zero-Sen, had been initiated a year and a half after that of the Wildcat, the first A6M1 made its maiden flight on April 1 1939, and the A6M2s first saw combat operations in August 1940. Total time between preliminary design studies and squadron operations was thus 39 months for the Japanese aircraft and 61 months for its American counterpart. Obviously, as our pilots were to grimly discover over the Pacific Ocean, we did not enjoy the benefit of a technological gap, as our 'experts' were leading us to believe. Yet we do not appear to have learnt from our past mistakes, and today we have sadly neglected the development of superior fighting machines.

Design history

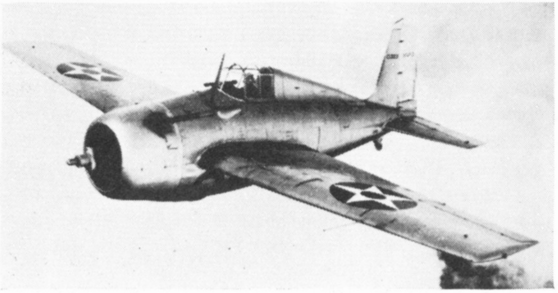
Shortly after their XF3F-1 had reached flight trial status Grumman Aircraft Engineering Corporation began preliminary studies on a new high-performance biplane carrier fighter, and on March 2 1936 were awarded a prototype contract for this aircraft, the XF4F-1. Improvements in the F3F series and the award on June 22 1936 to the Brewster Company of a contract for their XF2A-1 monoplane prototype finally convinced Grumman that the biplane fighters were things of the past, and they suspended work on their XF4F-1 to concentrate on designing a new monoplane carrier fighter. Powered by a Pratt & Whitney R-1830-66 fourteen-cylinder, air-cooled radial driving a two-pitch three-blade Hamilton Standard propeller and armed with two fuselage-mounted 0.50-in. machine-guns and two similar wing-mounted weapons, the aircraft was the object of a prototype contract awarded on July 28 1936. The XF4F-2 (BuNo. 0383) was a stubby little fighter with mid-mounted wings and typical Grumman retractable main undercarriage housed in the lower fuselage. First flown on September 2 1937, with Robert L. Hall at the controls, the aircraft was subjected to extensive competitive trials at Anacostia against the Brewster XF2A-1 and the Seversky NF-1. Even though the XF4F-2 was the fastest machine, officially reaching a top speed of 288 m.p.h. at 10,000 ft., the production contract was awarded to the 10 m.p.h. slower Brewster F2A1.

The prototype XF4F-2 Wildcat (BuNo. 0383) in original configuration without spinner and with rounded wing-tips. [*Grumman, via Francillon.*



Despite this setback Grumman obtained permission from the U.S. Navy that they be authorised to extensively modify their aircraft to take advantage of the increased altitude rating of the Pratt & Whitney XR-1830-76 fitted with a two-stage, two-speed supercharger and driving a Curtiss Electric constant-speed propeller. Retaining most of the fuselage structure of the XF4F-2, the XF4F-3 featured redesigned square-tipped wings and tail surfaces, and span and wing area were respectively increased from 34 ft. to 38 ft. and from 232 sq. ft. to 260 sq. ft., to compensate for weight increases. As the XF4F-3 made use of the original fuselage and undercarriage of the

The XF4F-3 (BuNo. 0383) photographed during its first flight on February 12 1939. [*Grumman, via Francillon.*



XF4F-2 it retained the BuNo. 0383, and in this configuration made its first flight on February 12 1939. Despite protracted difficulties with engine cooling—a variety of spinners being tested but finally abandoned in favour of using a propeller with wide-chord cuffs—the aircraft reached a maximum speed of 333.5 m.p.h. at 21,300 ft., a gain of almost 16 per cent over the top speed of the XF4F-2. Consequently, on August 8 1939, Grumman were awarded an initial production contract for 78 F4F-3s. However, the XF4F-3 was not yet out of the woods and manufacturer's trials, service tests—including carrier qualification—and wind-tunnel tests in the N.A.C.A. full-scale wind-tunnel at Langley Field, Virginia, resulted in a series of modifications which chronologically included an increase in wing dihedral, an enlargement of the rudder horn balance and the fitting of modified tail surfaces with dorsal fin extension and horizontal stabiliser raised some 20 inches. Unfortunately the aircraft was lost at Norfolk, Virginia, on December 16 1940, when it crashed. However, some ten months earlier the first production F4F-3 (BuNo. 1844) had made its first flight and the future of the aircraft was assured as, in addition to U.S. Navy contracts, it had received contracts from the French (G-36A) and the British (G-36B) Governments.

Wildcat development

F4F-3: First production model of which 285 were built (BuNos. 1844 and 1845, 1848 to 1896, 2512 to 2538, 3856 to 3874, 3970 to 4057 and 12230 to 12329). The first two aircraft differed in being armed with two fuselage-mounted 0.30-in. machine-guns and two wing-mounted 0.50-in. machine-guns (same armament as the prototype) whilst all other aircraft were armed with four wing-mounted 0.50-in. machine-guns. Pratt & Whitney R-2800-76 with two-speed two-stage supercharge rated at 1,200 h.p. on take-off. The name 'Wildcat' was officially adopted for the aircraft on October 1 1941. One aircraft was tested in 1944 with breakaway wing-tips in which 3 ft. 6 in. of each wing were designed to break when *g*-force exceeded 8 to 9.

F4F-3A: As a safeguard against potential teething troubles with the R-1830-76 engine the U.S. Navy ordered 95 aircraft (BuNos. 3875 to 3969) powered by a R-1830-90 with single-stage, two-speed supercharger as tested on the XF4F-6. Airframe similar to that of the F4F-3. First thirty aircraft released for delivery to Greece but taken over by the Fleet Air Arm as Martlet IIIs.

F4F-3S: One F4F-3 (BuNo. 4038) experimentally fitted with twin Ede floats during the fall of 1942. Later a ventral fin and auxilliary fins on the stabiliser were added. Maximum speed decreased from 330 m.p.h. to 240 m.p.h. and the planned conversion of 100 additional F4F-3s was not realised. First flight on February 28 1943.

XF4F-4: One prototype (BuNo. 1897) powered by a Pratt & Whitney R-1820-90 and armed with four wing-mounted 0.50-in. machine-gun. Hydraulically operated folding wings, improved armour and self-sealing tanks. First flight on April 14 1941. Weight empty increased from 5,342 lb. for the F4F-3 to 5,776 lb. for the XF4F-4, whilst top speed decreased from 330 m.p.h. to 326 m.p.h.

F4F-4: Production version of the XF4F-4 with manually operated folding wings. R-1830-90 engine and six wing-guns. Five were delivered in late 1941 and 1,164 during 1942 (BuNos. 4058 to 4098, 5030 to 5262, 01991 to 02152, 03385 to 03544 and 11655 to 12227). Two F4F-4s were used at the Naval Aircraft factory in a series of tests intended to increase the useful range of the aircraft. To that effect the aircraft were towed with engine feathered behind bomber aircraft, Navy's Douglas BD-1s and Army's Boeing B-17s, at a cruise speed of 180 m.p.h. After starting their engine in flight the fighter could proceed on their own power.

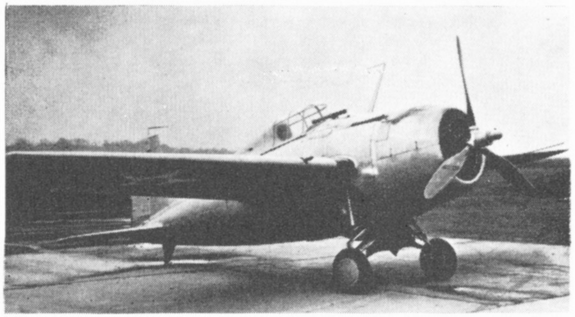
F4F-4B: Designation applying to 220 generally similar aircraft built under Lend–Lease contracts and delivered to the Royal Navy as Wildcat IVs.

XF4F-5: Two prototypes (BuNos. 1846 and 1847) with F4F-3-type airframes powered by a Wright R-1820-40, nine-cylinder air-cooled radial. The Wright installation had first been used on the G-36As purchased by France and delivered as Martlet Is to the Royal Navy. BuNo. 1846 was later tested with a turbo-supercharged R-1820-54, whilst BuNo. 1847 received a XR-1820-48 with two-stage, two-speed supercharger.

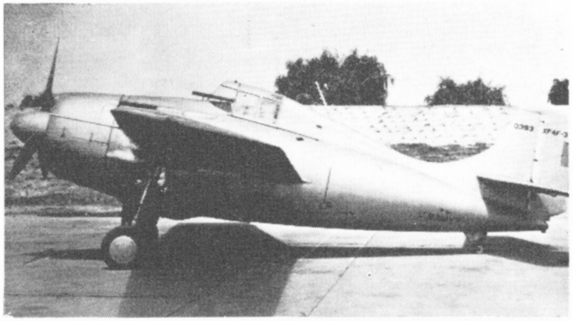
XF4F-6: One prototype (BuNo. 7031), powered by a Pratt & Whitney R-1830-90 with single-stage, two-speed supercharger. Later redesignated XF4F-3A.

F4F-7: Long-range, unarmed photo-reconnaissance version of the F4F-3 of which 21 (BuNos. 5263 to 5283) were built in 1942. Fuel-tanks with a capacity of 555 U.S. gallons were installed in the wing to supplement the standard fuselage tanks and raised total petrol capacity to 685 U.S. gallons. Maximum range was increased to a spectacular 3,700 miles.

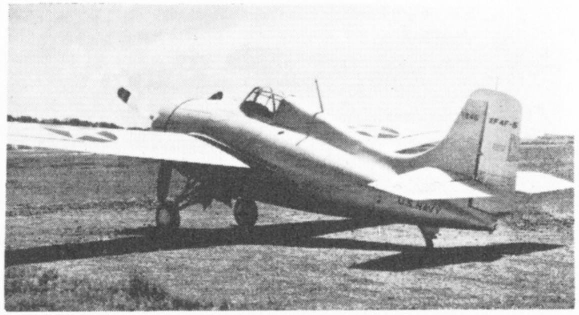
XF4F-8: Powered by Wright R-1820-56 nine-cylinder air-cooled radial, two XF4F-8s (BuNos. 12228 and 12229) were built by Grumman to serve as proto-



XF4F-3 in the summer of 1939. Note wing-mounted machine-guns and chord propeller cuffs. [*Grumman, via Francillon.*

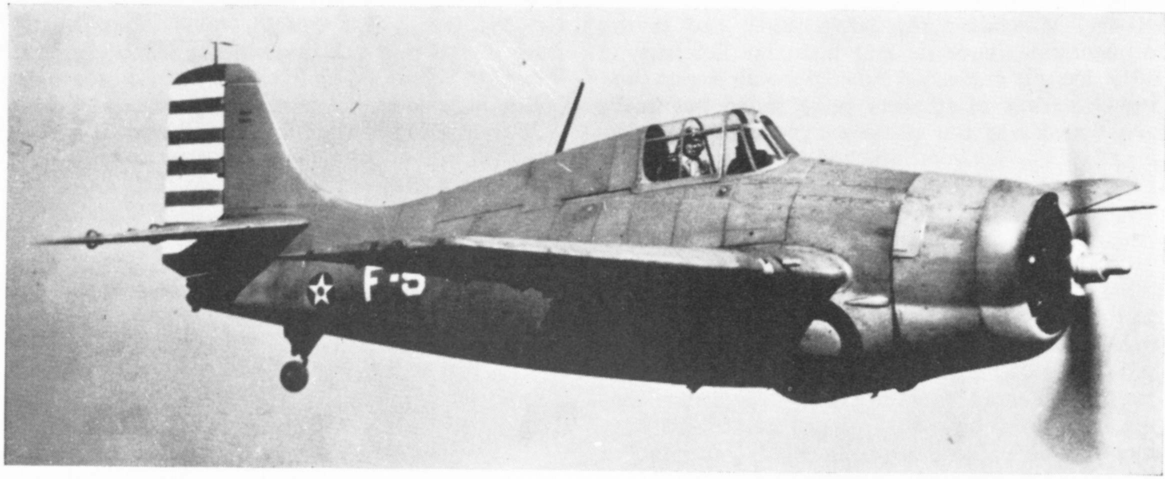


XF4F-3 in June 1940 after modifications to tail surfaces. Note large spinner. [*Grumman, via Francillon.*



The first XF4F-5 (BuNo. 1845) with Wright R-1820-40 radial engine. [*U.S.N., via Francillon.*

F4F-3 from VF-2 operating from U.S.S. Yorktown *in early 1942. Note small fuselage star insignia. [U.S.N., via Francillon.*



types for a version of the F4F-4 with shorter take-off characteristics for use aboard escort carriers. Armament was reduced to four wing-mounted 0.50-in. machine-guns. Production of the aircraft was entrusted to the Eastern Aircraft Division of General Motors. First flight on November 8 1942.

FM-1: To enable Grumman to concentrate on the production of their F6F Hellcat and on the design of new types, the U.S. Navy decided early in 1942 to transfer the production of the Wildcat to the Eastern Division of General Motors at Linden, New Jersey. The first G.M.-built aircraft, designated FM-1, was similar to the F4F-4 and made its first flight on August 31 1942. FM-1 production included 1,060 aircraft for the U.S. Navy (BuNos. 14992 to 15951 and 46738 to 46837), of which 222 were later transferred to the Royal Navy as Wildcat Vs, and 90 aircraft ordered under Lend–Lease contracts for the Royal Navy. Four wing guns only but ammunition capacity increased (430 r.p.g. versus 240 r.p.g. for the six guns of the F4F-4).

FM-2: Production version of the XF4F-8 characterised by redesigned tail surfaces. More FM-2s were built than all other Wildcat versions put together, with 4,777 FM-2s (BuNos. 15952 to 16971, 46838 to 47437, 55050 to 55649, 56684 to 57083, 73499 to 75158 and 86291 to 86973) being delivered between September 1943 and August 1945. Of these 370 were delivered to the Royal Navy as Wildcat VIs. Provision for six 5-in. rockets on underwing zero-length launchers.

XF2M-1: Projected development of the G.M.-built Wildcat planned around the use of the 1,500 h.p. Wright XR-18200-70 nine-cylinder turbo-supercharged air-cooled radial. Three prototypes (BuNos. 82855 to 82857) ordered in 1944 but cancelled after V.J.-Day before completion of the first aircraft.

Service history

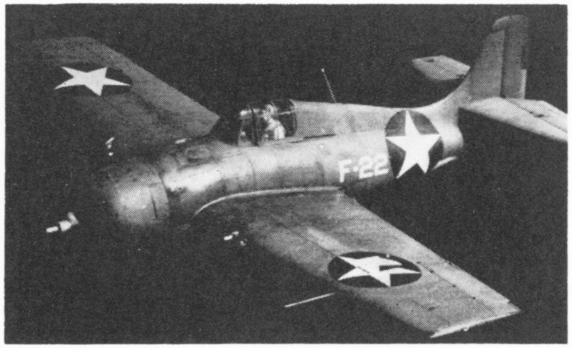
The Wildcat was first delivered to operational units in December 1940, when VF-4 (later VF-41) of the *Ranger* took delivery of some F4F-3s. By the end of the following year, shortly after Japan had pushed the United States into the Second World War, the U.S. Navy had taken delivery of 183 F4F-3 and 65 F4F-3As, and the following units were equipped with Wildcats:

U.S.N. VF-3, VF-5, VF-6, VF-8, VF-41, VF-42, VF-71, VF-72.

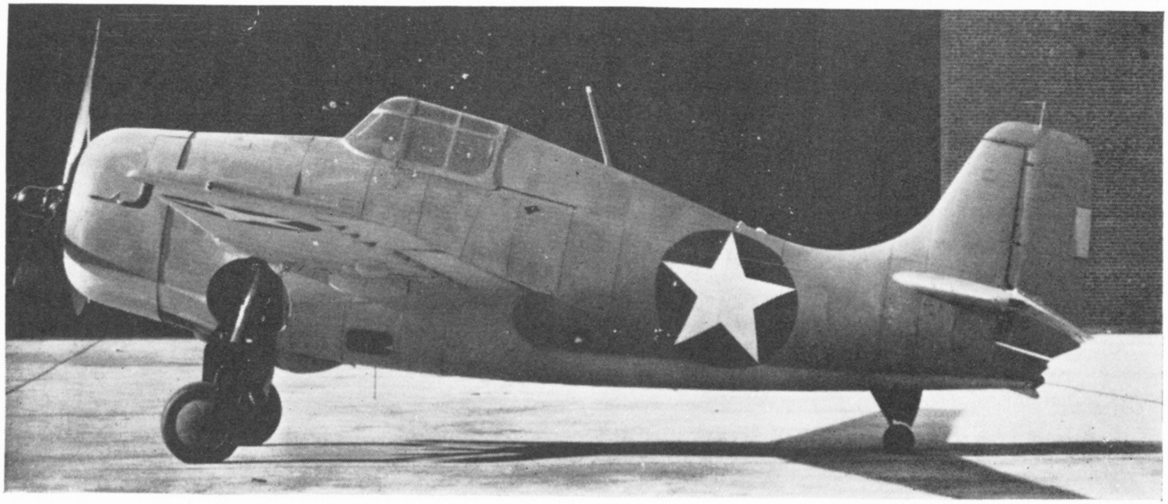
U.S.M.C. VMF-121, VMF-211.

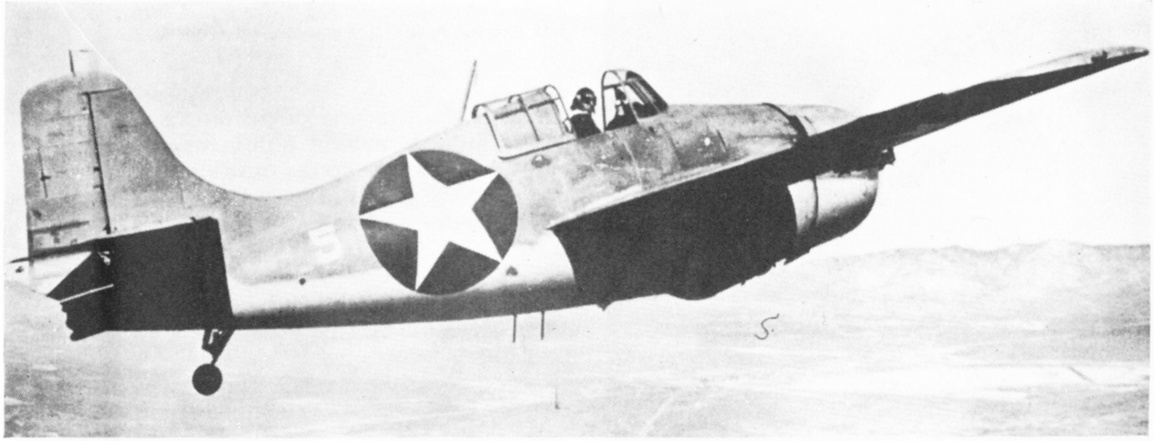
On December 7 1941 half of VMF-211 complement was based at Ewa MCAS, Oahu, whilst the other twelve aircraft of this squadron had just been delivered to Wake Island. At Ewa nine F4F-3s of VMF-211 were destroyed on the ground during the initial Japanese attack but over Wake VMF-211 pilots fought an heroic battle for two weeks until December 22 1941, when their last two aircraft were destroyed after

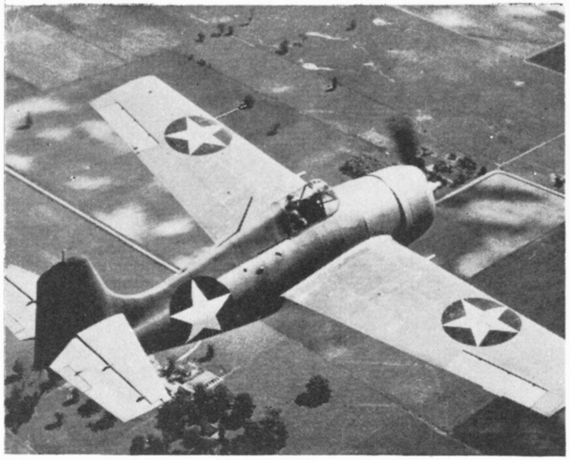
September 1942; the war is nine months old. Gone are the red-and-white rudder stripes; added are the large white star in a blue circle. This F4F-3 has odd panel in port white insignia. [U.S.N., via Francillon.



One of two XF4F-8s built by Grumman. Both aircraft served as prototypes for the FM-2 series. [Grumman, via Francillon.





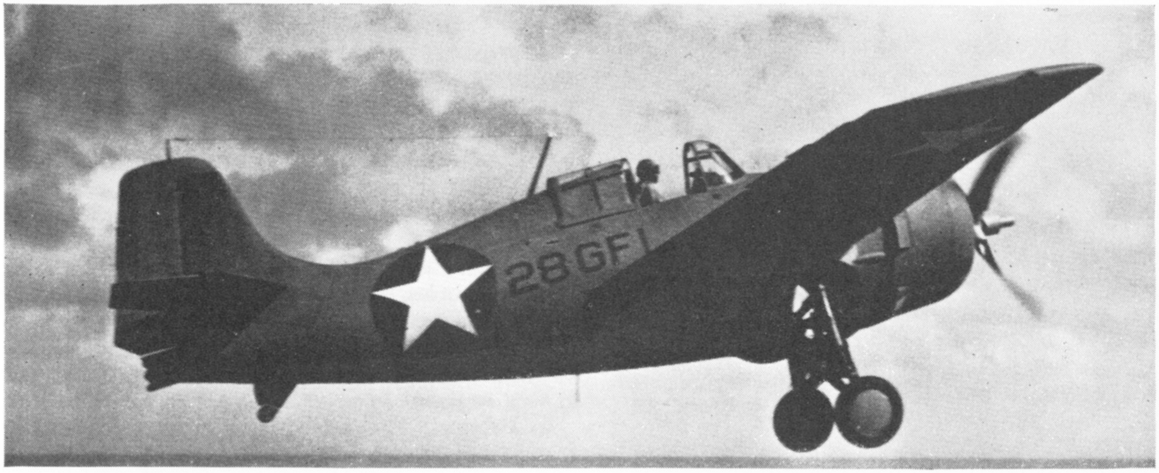


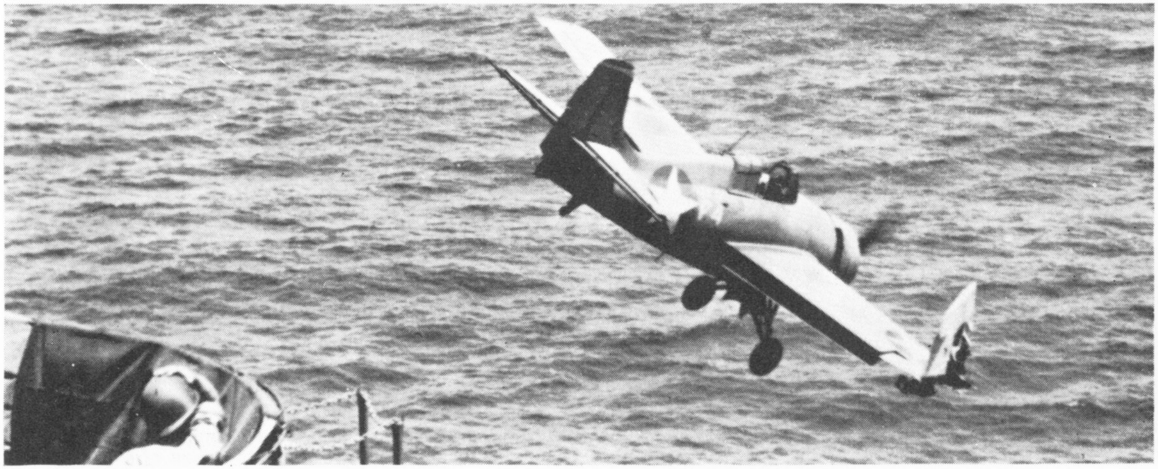
Above left: F4F-4 on a training mission over Southern California. [*U.S.N., via Francillon.*

Above: Basic plan view of the Wildcat is evident in this photograph. Note extended arrester hook. [*U.S.N., via Francillon.*

obtaining the first Wildcat's victory over the Mitsubishi A6M2 Zero-Sen. The next conclusive action for the Wildcat took place on February 1 1942, when five aircraft from VF-6 (U.S.S. *Enterprise*), led by Lt-Cdr Jim Gray, were credited with two Japanese fighter aircraft destroyed during an escort mission over Taroa in the Marshall Islands. For the next three months the Wildcats took part in a series of raids against Japanese-held islands and they provided fighter cover for the U.S.S. *Hornet* during the famous Doolittle raid. It is during this period of time that Lt-Cdr John S. Thach perfected his noted formation, the Thach weave, and that Lt Edward H. ('Butch') O'Hare gained fame when, on February 22, he destroyed five Japanese twin-engined bombers.

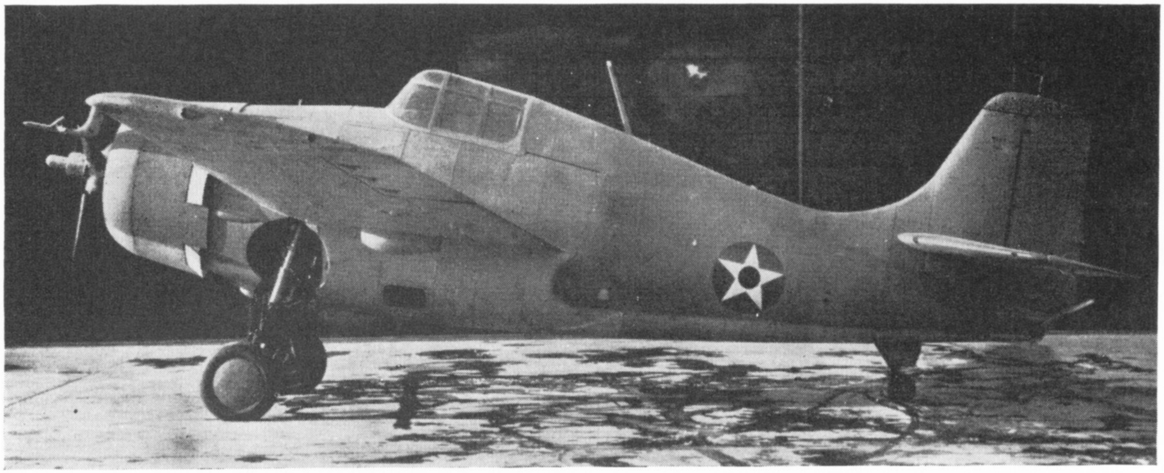
In May and June 1942 the two decisive carrier battles of Coral Sea and Midway were fought, and Wildcats of VF-2 and VF-3 (U.S.S. *Yorktown*), VF-41 (U.S.S. *Lexington*), VF-6 (U.S.S. *Enterprise*), VF-8 (U.S.S. *Hornet*) and VMF-221 (on Midway Island) managed—through excellent pilot training, efficient combat formation and Japanese tactical errors—to

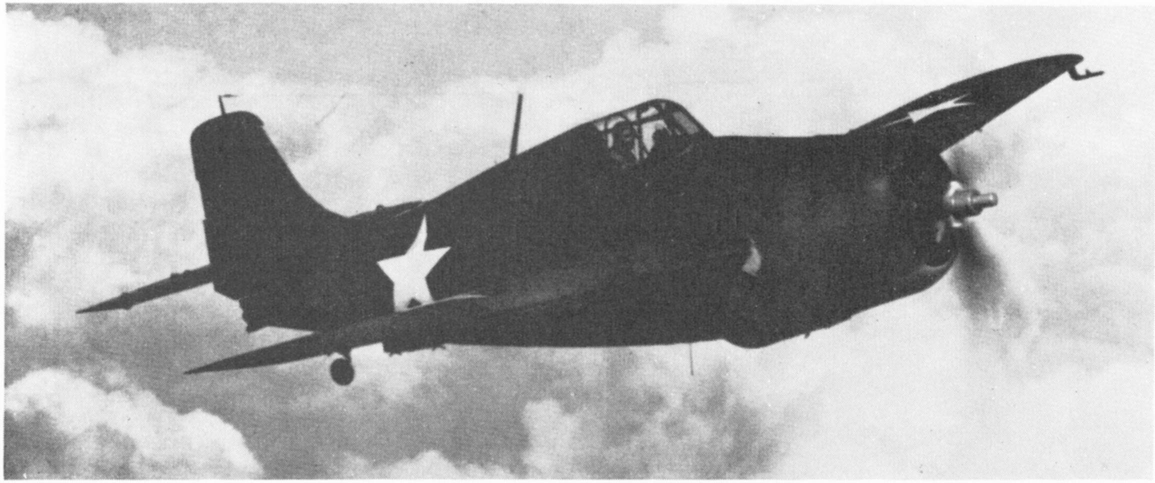


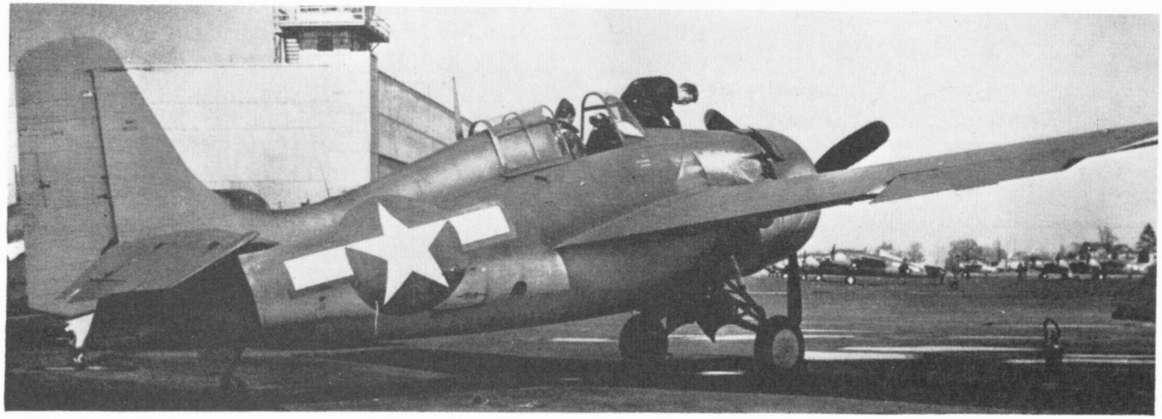


Left, middle: An F4F-4 of VGF-28 on October 10 1942. A month later this unit operated from U.S.S. Suwanee *during 'Operation Torch' in North Africa.* [*U.S.N., via Francillon.*

Left, bottom: A Wildcat overshoots after hitting its carrier's bridge with starboard wing. The pilot was rescued. [*U.S.N., via Francillon.*







A photo-reconnaissance F4F-7. Note fuel jettison discharge pipe beneath rudder. [*Grumman, via Francillon.*

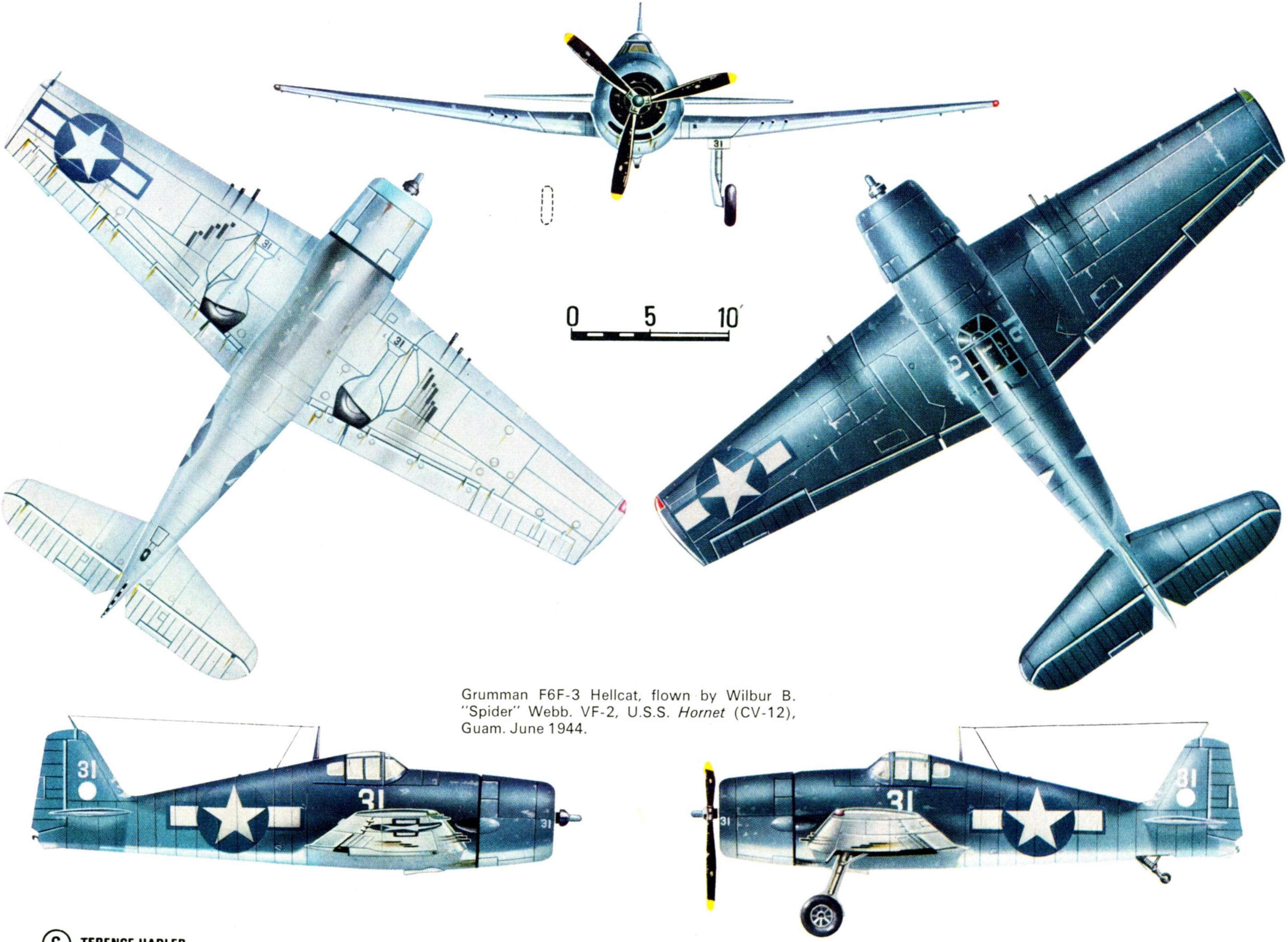
overcome the handicap of performances inferior to those of the Mitsubishi A6M2 Zero-Sen and contributed significantly to the American victories. Later during that year and in early 1943 the Guadalcanal-based Wildcats of U.S.M.C. squadrons VMF-112, -121, -122, -212, -223 and -224 achieved spectacular success. Amongst noted pilots taking part in these operations were Capt Joseph Foss—who on January 15 1942 became the first W.W.II U.S. pilot to equal Eddie Ricenbacker's score of 26 kills—Major Marion Carl and Lt-Col John Smith. During the same period carrier-based Wildcats operating from the U.S.S. *Wasp* (VF-71), U.S.S. *Enterprise* (VF-6 and VF-10), U.S.S. *Saratoga* (VF-5) and U.S.S. *Hornet* (VF-72) took part in a series of carrier battles in the Solomons, during which Lt Stanley Vejtasa of VF-10 bagged five Japanese Nakajima B5N2 topedo bombers in a single engagement.

During 'Operation Torch', the Allied invasion of North Africa, the U.S. Navy provided three carriers embarking a total of 68 F4F-4s distributed amongst the following squadrons: VF-41 (U.S.S. *Ranger*), VGF-26 (U.S.S. *Sangamon*), and VGF-27, -28 and -30 (U.S.S. *Suwanee*). Opposition by the Vichy Air Force did not last long and soon the Wildcats were able to provide direct support to ground forces. Fortunately for the fast obsolescent Wildcats they had been replaced by Army Air Forces fighters by the time the Luftwaffe arrived *en force*.

In February 1943 Vought F4U-1 Corsairs began to replace Wildcats in land-based operations squadrons and in August 1943 the Grumman F6F-3 Hellcats made their combat début. As production of both types was already well under way it could have meant the end of the Wildcat's combat career. However, in May 1941 the U.S. Navy had received the first of their escort carriers, the U.S.S. *Long Island.* The lighter, smaller Wildcats were ideally suited for operations from the shorter deck of the escort carriers, whilst their less impressive performances were not as detrimental in the types of operations to which escort carriers were to be assigned: convoy escort and ground support of amphibious forces. In these roles the Wildcats, particularly the G.M.-built FM-1s, and FM-2s,

Left, middle: The FM-1 Wildcat, constructed by General Motors. [*U.S.N., via Francillon.*

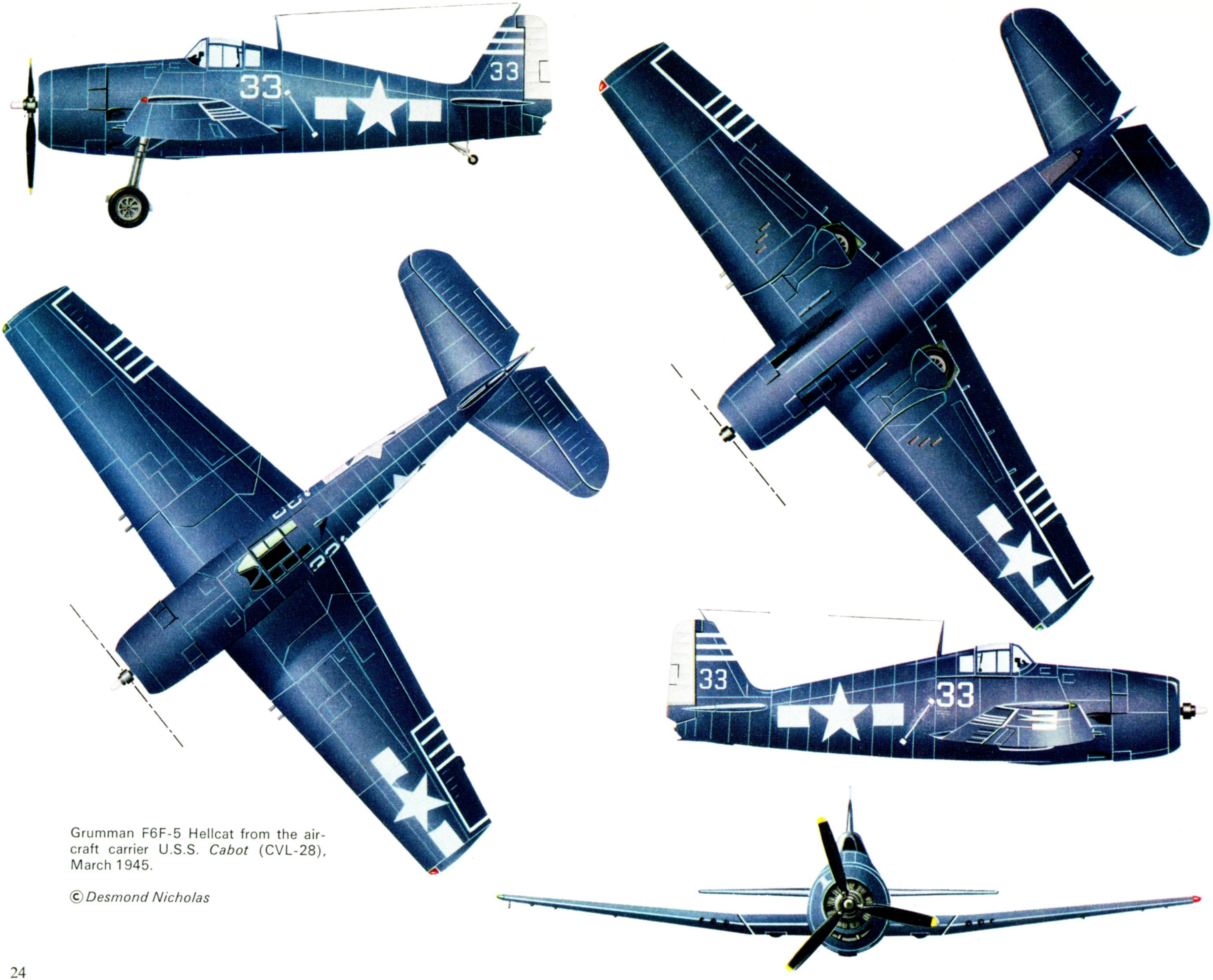
Left, bottom: Characterised by its taller fin and rudder, the General Motors FM-2 was the final variant of the Wildcat.



Grumman F6F-3 Hellcat, flown by Wilbur B. "Spider" Webb. VF-2, U.S.S. *Hornet* (CV-12), Guam. June 1944.

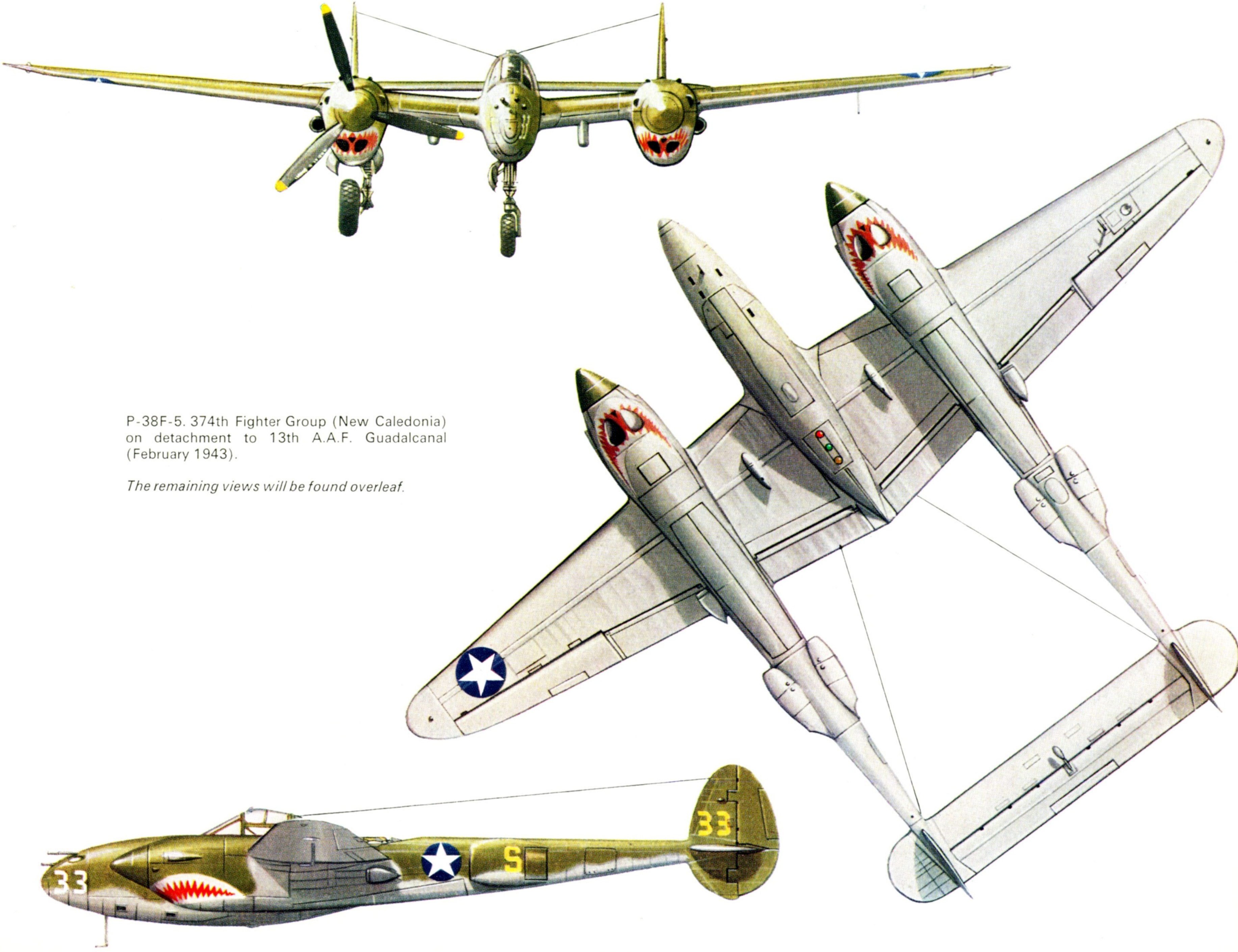
Ⓒ **TERENCE HADLER**

AFI/BB



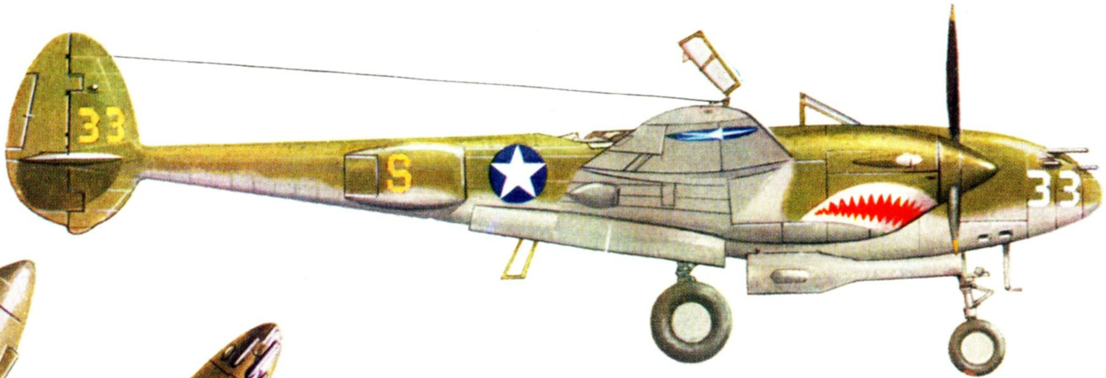
Grumman F6F-5 Hellcat from the aircraft carrier U.S.S. *Cabot* (CVL-28), March 1945.

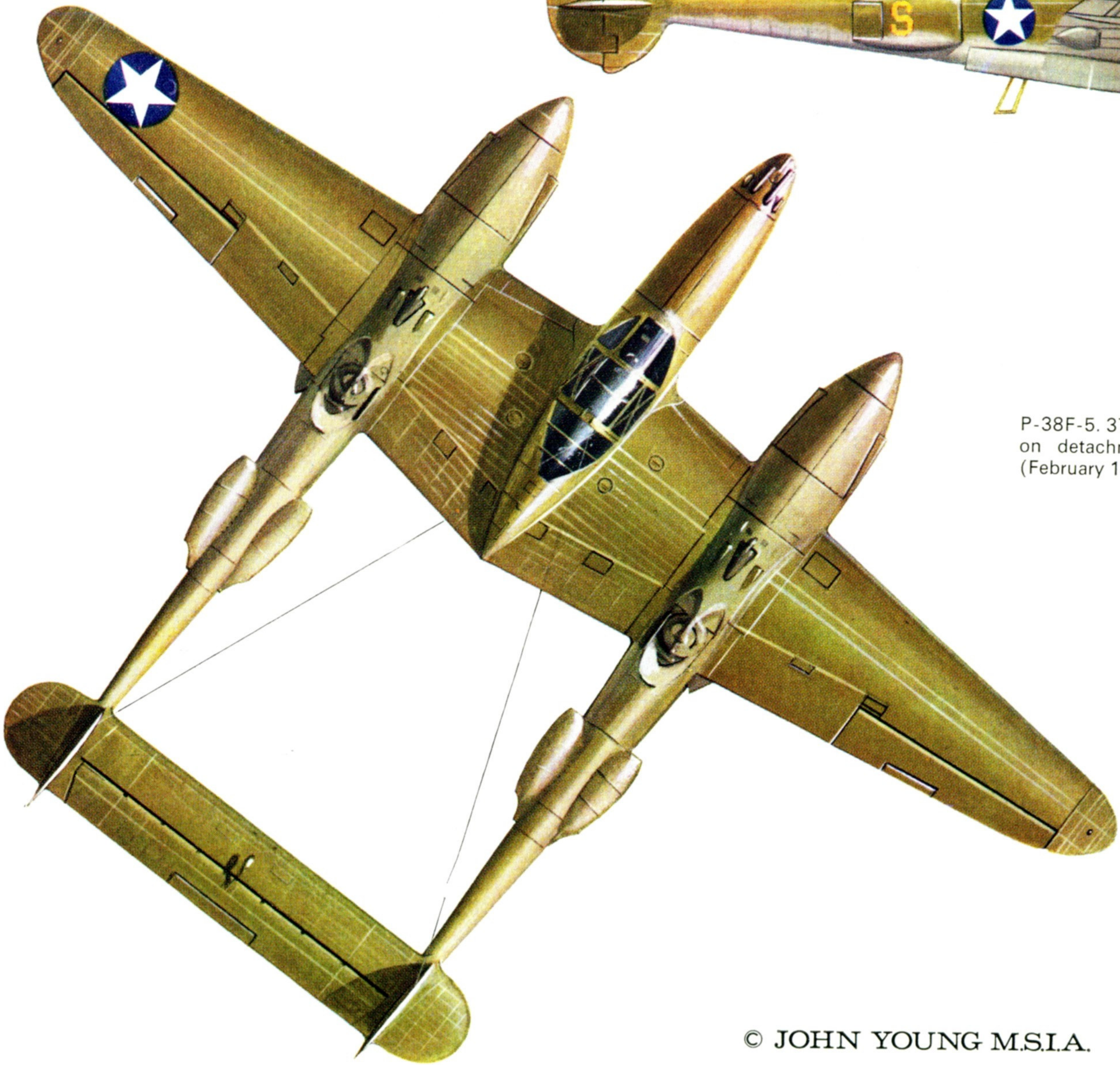
© *Desmond Nicholas*



P-38F-5. 374th Fighter Group (New Caledonia) on detachment to 13th A.A.F. Guadalcanal (February 1943).

The remaining views will be found overleaf.





P-38F-5. 374th Fighter Group (New Caledonia) on detachment to 13th A.A.F. Guadalcanal (February 1943).

© JOHN YOUNG M.S.I.A.

A Wildcat undergoing undercarriage retraction tests. [*U.S.N., via Francillon.*

soldiered on until the end of the war. Their task was no longer as spectacular but, on at least one occasion, they prevented what could have become a major Allied defeat. On October 25 1944, Task Group 77.4, commanded by Rear-Adm T. L. Sprague and including fifteen jeep carriers, was in the Samar Sea to provide anti-submarine protection and support to Allied landing forces. Surprised by a strong Japanese surface fleet, TG 77.4 launched their aircraft, including a large number of Wildcats, armed with whatever weapons were available: rockets, depth-charges and anti-personnel bombs. The price paid was high but the Japanese failed in their attempt to throw back the American beachhead.

The Wildcat evaluated

Credited with the destruction of 1,327 enemy aircraft, mainly Japanese, during the war, the Wildcats provided the U.S. Navy with a reliable, well-armed and well-protected but out-performed, fighter aircraft which helped contain the victorious Japanese advance until more modern equipment became available to turn the tide. Few will dispute the fact that in fighter-versus-fighter combat the Wildcat was inferior in term of performances to its arch-enemy, the Zero-Sen. Except at sea-level, where both types were equally as fast, the Japanese fighter was faster than the Wildcat and could easily outclimb the Grumman fighter.

However, the F4F was more strongly built and better protected and, when having the advantage of altitude, could inflict telling damage to the flimsier Japanese machines. In combat against bomber aircraft the Wildcats could easily claw their adversaries, as they proved time and again over Wake, the Coral Sea and Guadalcanal.

Better tactics and, later, the advantage of operating under radar control provided the Wildcats with the necessary tools to operate successfully against the Japanese, but it was fortunate for the U.S. Navy that the Hellcats were available in time for the offensive of 1944.

Specification	XF4F-2	F4F-3	F4F-4	FM-2
Span, ft. in.	34 0	38 0	38 0	38 0
Length, ft. in.	26 5	28 9	28 9	28 11
Height, ft. in.	11 0	11 10	11 10	11 5
Wing area, sq. ft.	232	260	260	260
Empty weight, lb.	4,036	5,342	5,785	5,448
Loaded weight, lb.	5,535	7,002	7,406	7,487
Maximum weight, lb.	—	8,152	7,952	8,271
Wing loading, lb./sq. ft.	23.9	26.9	28.5	28.8
Power loading, lb./h.p.	5.3	5.9	6.2	5.5
Maximum speed, m.p.h./ft.	288/10,000	330/21,100	318/19,400	332/28,800
Cruise speed, m.p.h./ft.	—	147	155	164
Climb rate, ft./min.	—	2,265/1	1,950/1	3,650/1
Service ceiling, ft.	29,540	37,500	34,900	34,700
Normal range, miles	—	845	770	900
Maximum range, miles	—	1,690	1,100	1,310
Power plant	R-1830-66	R-1830-76	R-1830-86	R-1820-56
T.O. rating, h.p.	1,050	1,200	1,200	1,350
Maximum rating, h.p./ft.	900/12,000	1,000/19,000	1,000/19,000	1,000/14,700
Armament	2×0.50 in.	4×0.50 in. 200-lb. bomb	6×0.50 in. 200-lb. bomb	4×0.50 in. 500-lb. bomb

Resplendent in its glossy blue finish is this FM-2 of the Marine Corps photographed shortly after the end of the war. [*U.S.N., via Francillon.*

Grumman F6F Hellcat

If ever a successful aircraft faded out in oblivion the Hellcat is that aircraft. Mainstay of the carrier-based fighter units of the U.S. Navy and the British Fleet Air Arm during the last two years of the Second World War, the Grumman F6F was officially credited by the Department of the Navy with the destruction of 5,156 enemy aircraft (4,947 aircraft by carrier-based Hellcats and 209 by land-based aircraft). Yet, today, the Vought F4U Corsair (credited with the destruction of only 2,140 enemy aircraft even though the type went into action six and a half months before the Hellcats and despite the fact that more F4Us than F6Fs were delivered during the war) is the most easily remembered naval fighter of the Second World War.

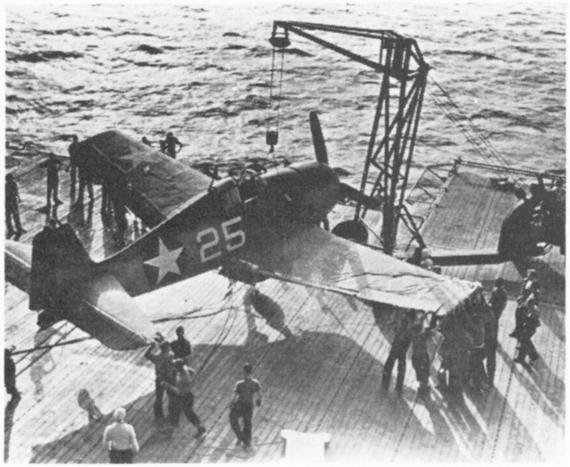
Indeed the performances of the Hellcat were not as spectacular as those of the Corsair, and the Vought machine had a better development potential, but there is little doubt that during the war the Grumman F6F was the most efficient naval fighter. It was tough, manœuvrable, well armed, well protected and could easily be operated from the deck of aircraft carriers. In short, it was successful and did much to help us win the war.

Design history

Whilst the Vought XF4U-1 was undergoing flight trials some elements of the U.S. Navy were becoming more and more concerned about the feasibility of using the aircraft aboard carriers due to its comparatively high landing speed and to poor visibility downward during landing approach. Meanwhile Grumman Aircraft Engineering Corporation, having just developed their XF4F-3 into a satisfactory type, began designing a potential successor to their first monoplane fighter. At this stage the proposed aircraft resembled a large, faster, longer-ranging F4F-3, and the proposed power plant was the 1,700 h.p. Wright R-2600-8 fourteen-cylinder air-cooled radial. The confidence of the U.S. Navy, stemming from the successful association between Grumman and their fighter units, in this firm's ability to produce a good carrier fighter, coupled with some misgivings regarding the ability of the Vought machine to operate from carriers, resulted, on June 30 1941, in a split decision. On this date Vought were awarded a first production contract for their F4U-1, whilst Grumman received a contract for two prototypes (BuNos. 02981 and 02982) of their new aircraft. The wisdom of this decision was to be amply rewarded less than two years later, when the Hellcats were assigned carrier duty whilst, initially at least, the Corsairs were relegated to land-based operations.

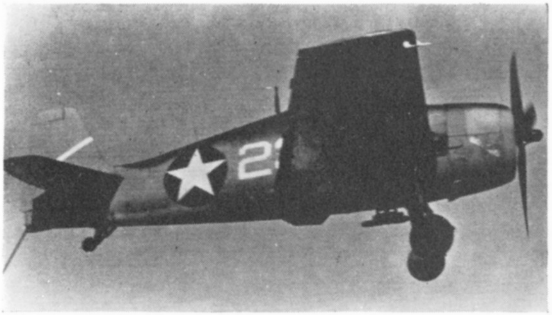
F6F-3 of VF-5 (*U.S.S.* Yorktown) *shortly after the Hellcat's service début. Aircraft is flown by Air Group Commander. [U.S.N., via Francillon.*

The XF6F-3 Hellcat after modification to full production standards. [U.S.N., via Francillon.

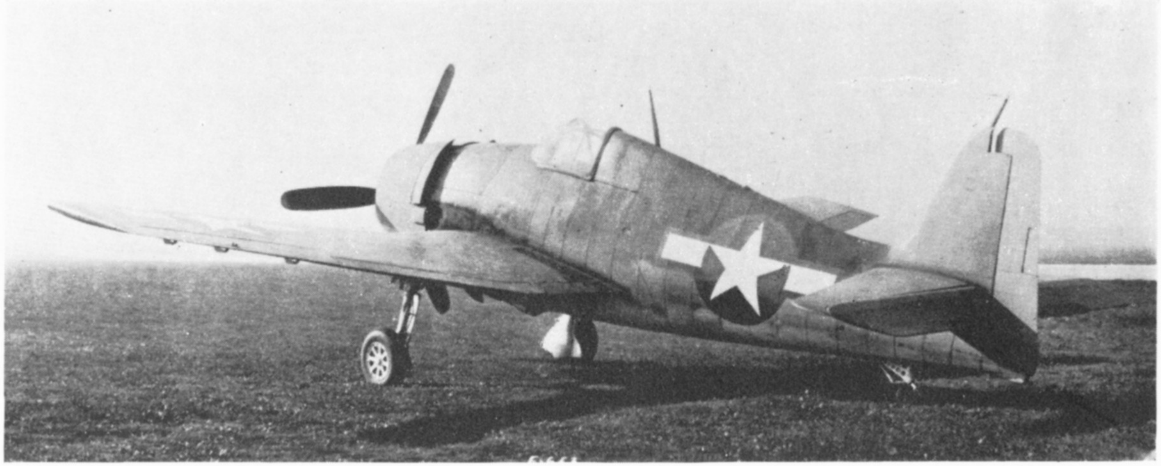


Early model F6F with damaged wing-tip aboard U.S.S. Yorktown (*CV-10*) *[A. G. Simmons, via F. Dial.*

The second half of 1941 saw rapid progress being made on the detailed design of the XF6F-1, but it soon became evident that a more powerful engine than the Wright R-2600 would be required to meet the performance requirements. Grumman then proposed to install on the XF6F-2 a turbo-supercharged Wright



Another Yorktown Hellcat. Note three-colour 'Basic Camouflage Scheme' (see drawing on page 27) and early use of individual carrier markings. [*A. G. Simmons, via F. Dial.*



Early production F6F-3 in three-tone finish and red outline and bar on national markings. [*via Francillon.*

R-2600, but anticipated late availability of this power plant resulted in a low priority being assigned to this project.

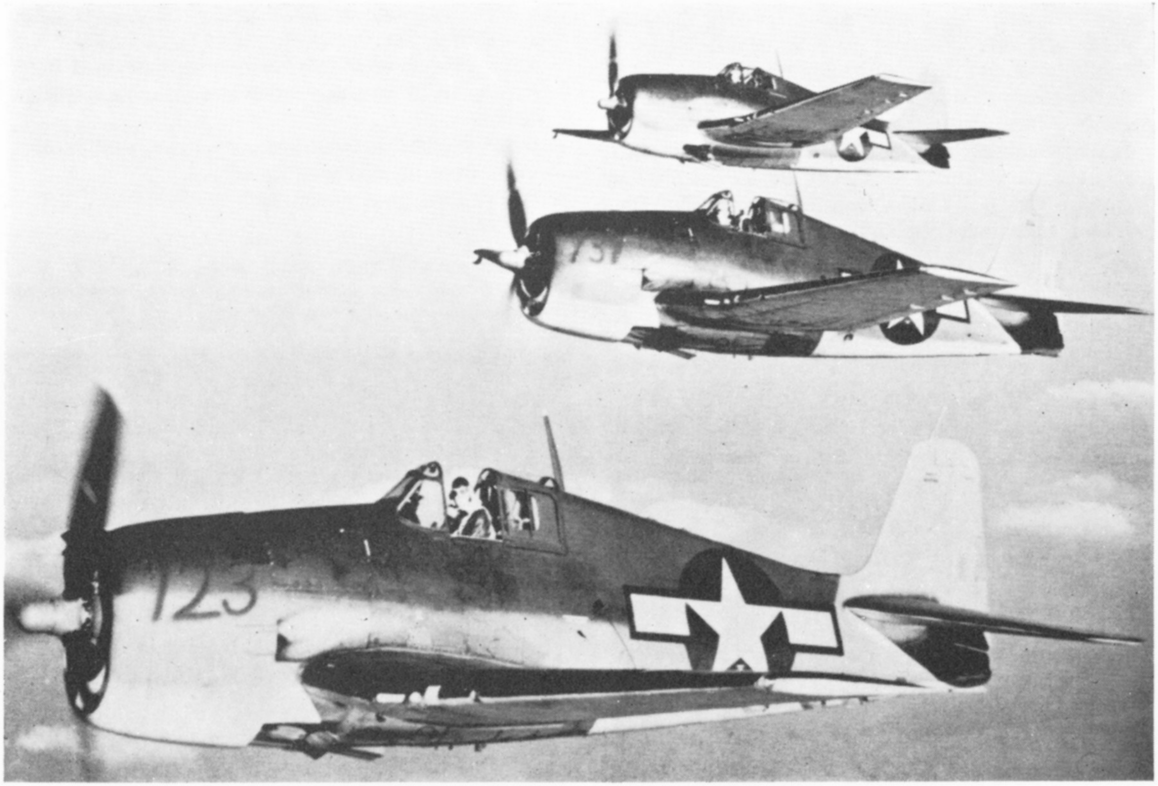
The Japanese attack on Pearl Harbour and the appearance of the formidable Zero-Sen brought a new urgency into the XF6F programme, which was re-directed to incorporate features dictated by early combat experience. As usually calculated, weights displayed a tendency to run away, and power had to be increased. Fortunately Grumman had already contemplated using other types of power plant, and it was decided to install on the second aircraft (BuNo. 02982) of the prototype contract, and on the initial production version, the Pratt & Whitney R-2800-10, the aircraft becoming the XF6F-3, whilst the first aircraft (BuNo. 02981)—the construction of which was too far advanced to enable a rapid switch to the R-2800 engine—was to retain the Wright R-2600. From then on the future of the aircraft was assured and the sequence of events accelerated considerably, as evidenced in this chronological list of significant events:

June 30 1941: Contract for two prototypes awarded.
Early 1942: Decision to use R-2800-10 on the XF6F-3 prototype.
May 23 1942: First production contract awarded.
June 26 1942: Maiden flight of the XF6F-1.
October 4 1942: First production F6F-3 (BuNo. 04775) completed.
January 16 1943: First assignment to Fleet unit (VF-9).
August 31 1943: Hellcat's combat début.

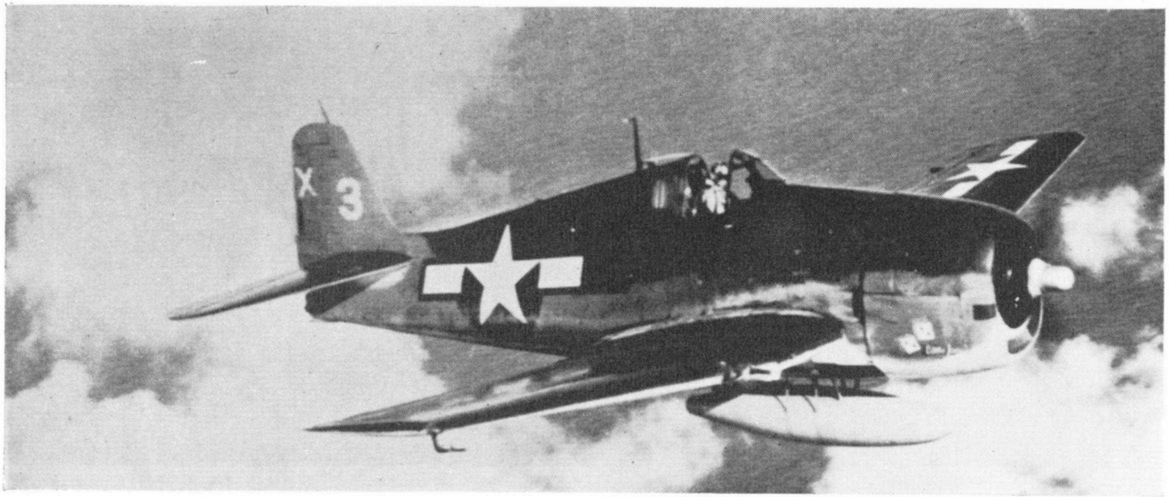
Twelve months from award of contract to first flight and fourteen more months to combat début. This was indeed quite an improvement upon the F4F records and a very significant achievement on the part of Grumman.

Hellcat development

XF6F-1: Prototype (BuNo. 02981) ordered on June 30 1941. R-2600-8 engine driving three-blade Curtiss



Group of F6F-3s show the large fuselage. Note crude numerals applied to cowling. [*U.S.N., via Francillon.*



Grumman F6F from VF-51, U.S.S. San Jacinto *(CVL-30) in June 1944. [U.S.N., via Francillon.*

Electric propeller fitted with large spinner. Proposed armament, not fitted, consisted in six 0.50-in. machine-guns with 400 r.p.g. First flight on June 26 1942 with Seldon S. Converse at the controls. Aircraft later modified as XF6F-4 prototype.

XF6F-2: Originally planned to be powered by a turbo-supercharged Wright R-2600 but project not realised. Designation later given to last F6F-3 (BuNo. 66244), experimentally fitted with a turbo-supercharged Pratt & Whitney R-2800-21 driving a four-blade propeller with wide-chord blade cuffs and spinner, in January 1944. Later the aircraft was converted back to F6F-3 configuration.

XF6F-3: Second prototype (BuNo. 02982) powered by an R-2800-10 radial driving a three-blade Curtiss Electric propeller fitted with a large spinner. Generally similar to the XF6F-1 with the exception of slightly modified cowling. First flight on July 30 1942. Flight trials progressed rapidly and were marred only by tail flutter problems which were solved by strengthening the rear fuselage.

F6F-3: First production version differing from the XF6F-3 in featuring modified main wheel fairings and in using a Hamilton-Standard three-blade propeller without spinner. A total of 4,403 F6F-3s were delivered between October 1942 and April 1944 (BuNos. 04775 to 04958, 08798 to 09047, 25721 to 26195, 39999 to 43137 and 65890 to 66244). Of these aircraft 18 were modified as F6F-3Es, 150 as F6F-3Ns and one as the XF6F-4 prototype, whilst 252 were delivered to the Fleet Air Arm as Hellcat Is. Most F6F-3s aircraft were powered by R-2800-10 but late production aircraft received R-2800-10W with water injection.

F6F-3E: Designation applying to eighteen F6F-3s fitted with AN/APS-4 radar in a pod on the starboard wing.

XF6F-3N: One F6F-3 modified in July 1963 to serve as a night-fighter prototype. Redesigned flat windshield and red instrument lighting system. AN/APS-6 radar in pod on starboard wing.

F6F-3N: Production version of the Hellcat night-fighter obtained by modifying 149 F6F-3 airframes to a standard similar to that of the XF6F-3N. One aircraft (BuNo. 65950) was experimentally fitted with a searchlight installed on the port wing bomb-rack.

Pranged Hellcat aboard U.S.S. Lexington *(CV-16) December 1943. Note insignia and the star with points extending into red outline. [A. G. Simmons, via F. Dial.*

XF6F-4: Designation applying to the original prototype (BuNo. 02981) modified to test the installation of an R-2800-27 with two-speed supercharger.

F6F-5: Incorporating all improvements progressively incorporated on the F6F-3s and F6F-3Ns—including flat windshield, red instrument lights, bomb racks, etc.—the F6F-5 featured new ailerons, strengthened tail surfaces and redesigned engine cowling, R-2800-10W engine and same armament as on the F6F-3 but provision for six 5-in. rockets on zero-length launchers. Late production aircraft could mount a 20 mm. cannon in place of the inboard machine-gun in each wing. Production, commencing in April 1944, totalled 7,868 aircraft including 1,434 machines fitted with radar as F6F-5Ns a small number of F6F-5Ps and 932 aircraft for the Fleet Air Arm (Hellcat IIs, F.R.IIs, and N.F.IIs). BuNos. assigned: 58000 to 58999, 69992 to 70189, 70912, 70914 to 72991, 77259 to 80258 and 93652 to 94521.

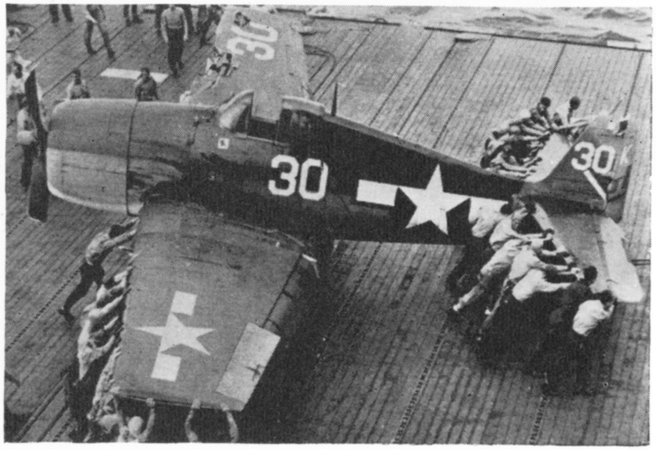
F6F-5K: Designation applying to a small number of F6F-5s modified as pilotless target drones. During the Korean War some of these aircraft were loaded with explosives and used as guided missiles.

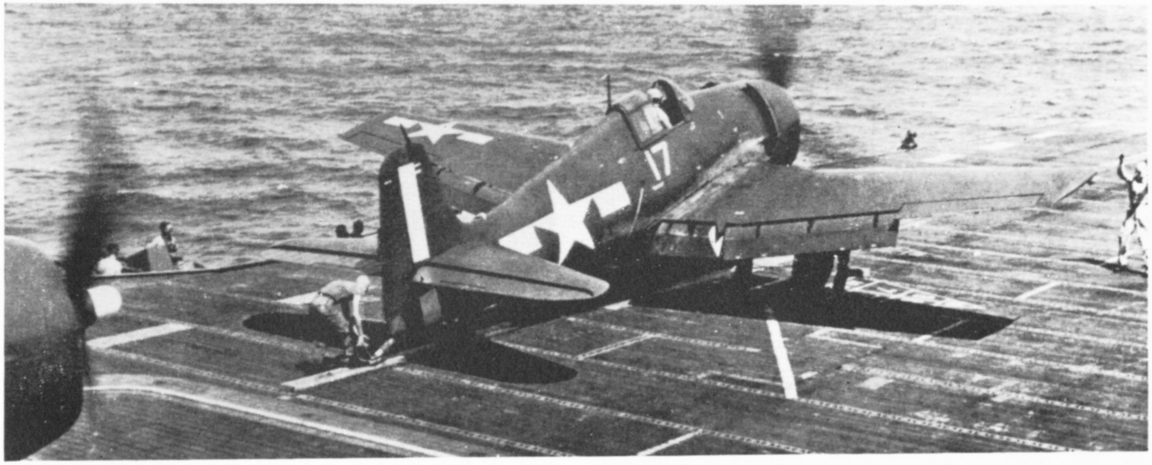
F6F-5N: A total of 1,434 F6F-5 airframes were modified on the assembly line as night-fighters with AN/APS-6 radar in a radome on the starboard wing. BuNo. 70729 was also fitted in 1945 with a searchlight.

F6F-5P: Fighter reconnaissance version with camera installation in the rear fuselage.

XF6F-6: Two prototypes (BuNos. 70188 and 70913)

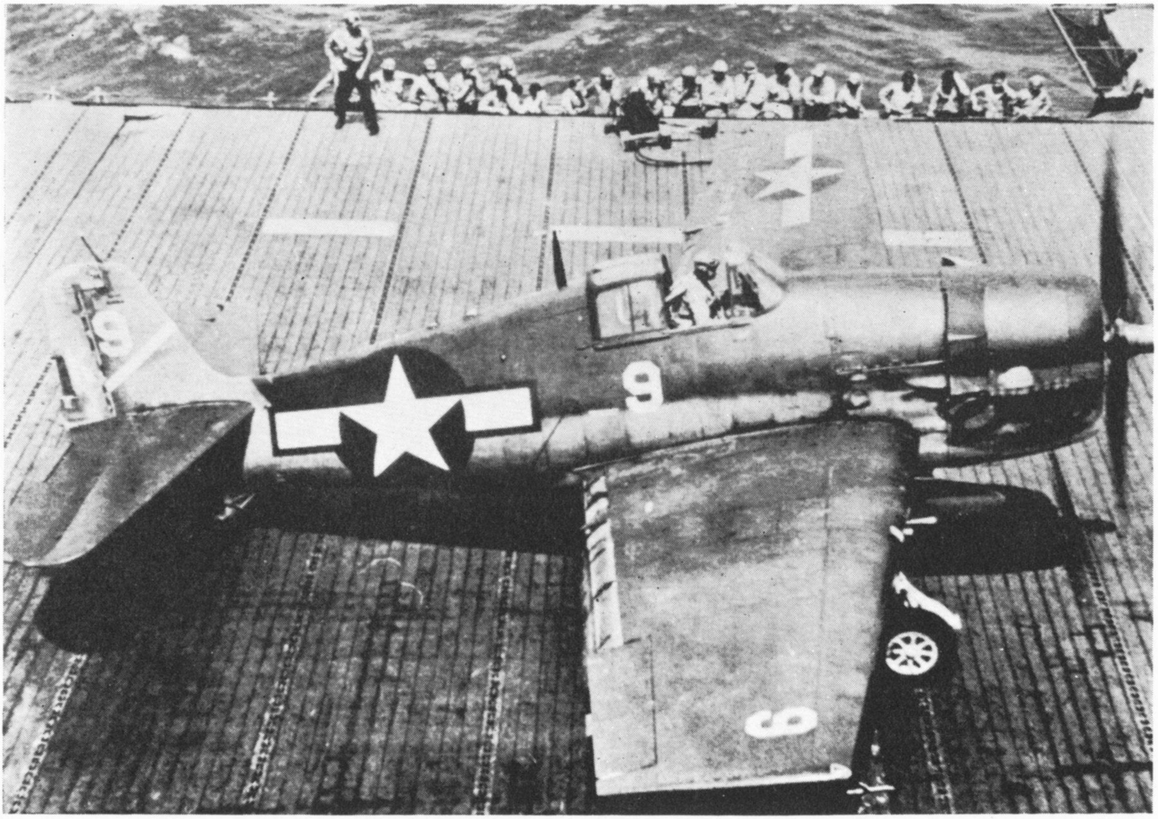
An F6F-3 from VF-3 after rough landing in June 1944. Note damaged wing and curious camouflage on rear dorsal fuselage. [U.S.N., via Francillon.

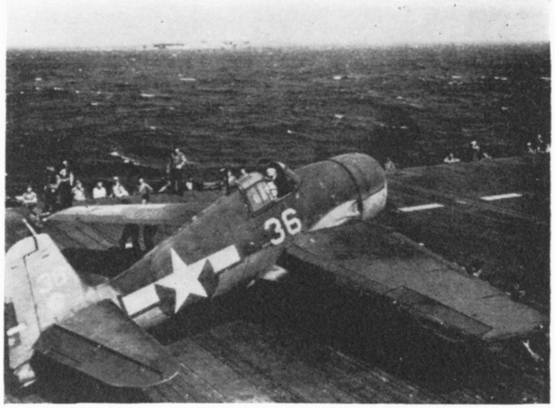




Above: Ready for catapult launch is this F6F-5 from VF-29 aboard the U.S.S. Cabot *(CVL-29), October 1944. [U.S.N., via Francillon.*

Below: A F6F-3 from VF-5 about to be launched from the Yorktown *(CV-10). [U.S.N., via Francillon.*





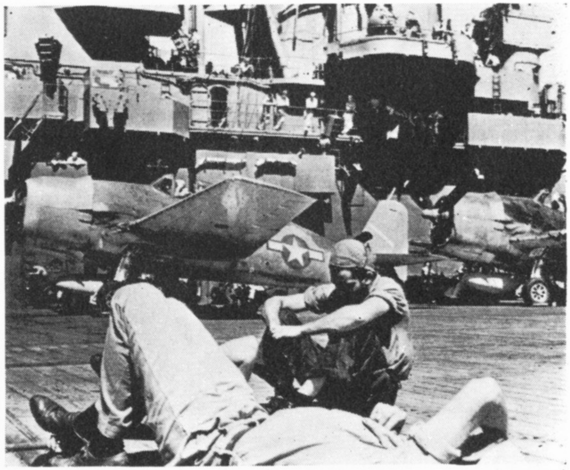
F6F of VF-2 flown by Wilber B. Webb aboard U.S.S. Hornet *June 1944 (CV-12). Webb flew this and the aircraft depicted in the drawing on page 27. White dot on fin indicated that aircraft belonged to the* Hornet.

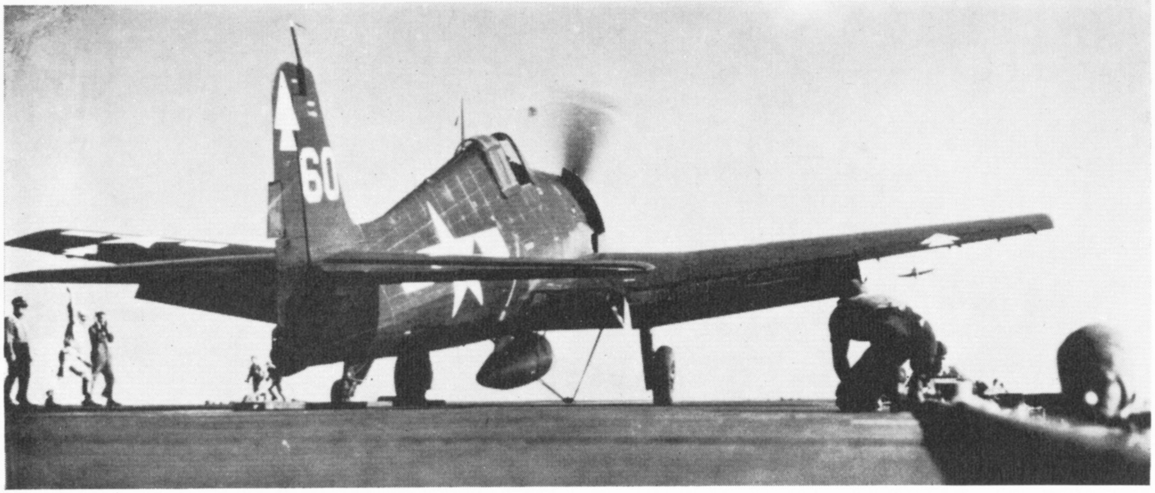
fitted with R-2800-18W radials driving four-blade propeller. First flight on July 6 1944. Even though maximum speed was increased to 417 m.p.h. at 21,900 ft. the aircraft was not ordered in production, as the R-2800-18W was in great demand for the faster F4U-4.

Service history

On January 16 1943 VF-9 assigned to the U.S.S. *Essex* (CV-9)—the first ship of a new class of fast aircraft

A Yorktown *F6F (November 1943) with the large blue disk insignia painted out and new bar insignia in its place. New markings were applied from June 29 1943. [A. G. Simmons, via F. Dial.*





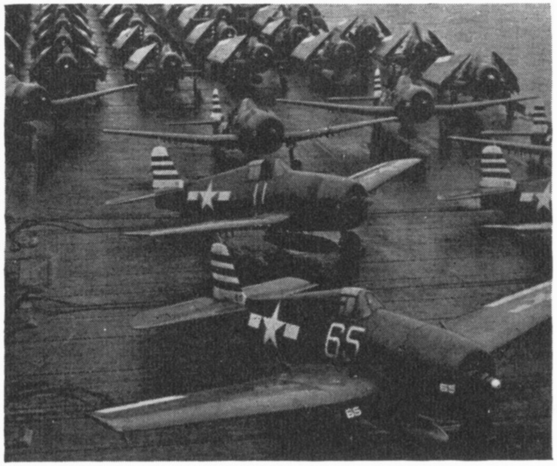
F6F-5 on the starboard catapult of the U.S.S. Bennington *(CV-20) in the spring of 1945. Note arrow head 'G' marking of Bennington on wings and fin.* [*via Francillon.*

carriers which had been commissioned on December 31 1942—became the first U.S. Navy fighter squadron to take delivery of F6F-3s. During the following seven months additional Hellcat-squadrons and *Essex*-class (CV) and *Independence*-class (CVL) carriers were added to the fleet, and ships, aircraft and men participated in a shakedown cruise to prepare themselves for the impending Allied offensive.

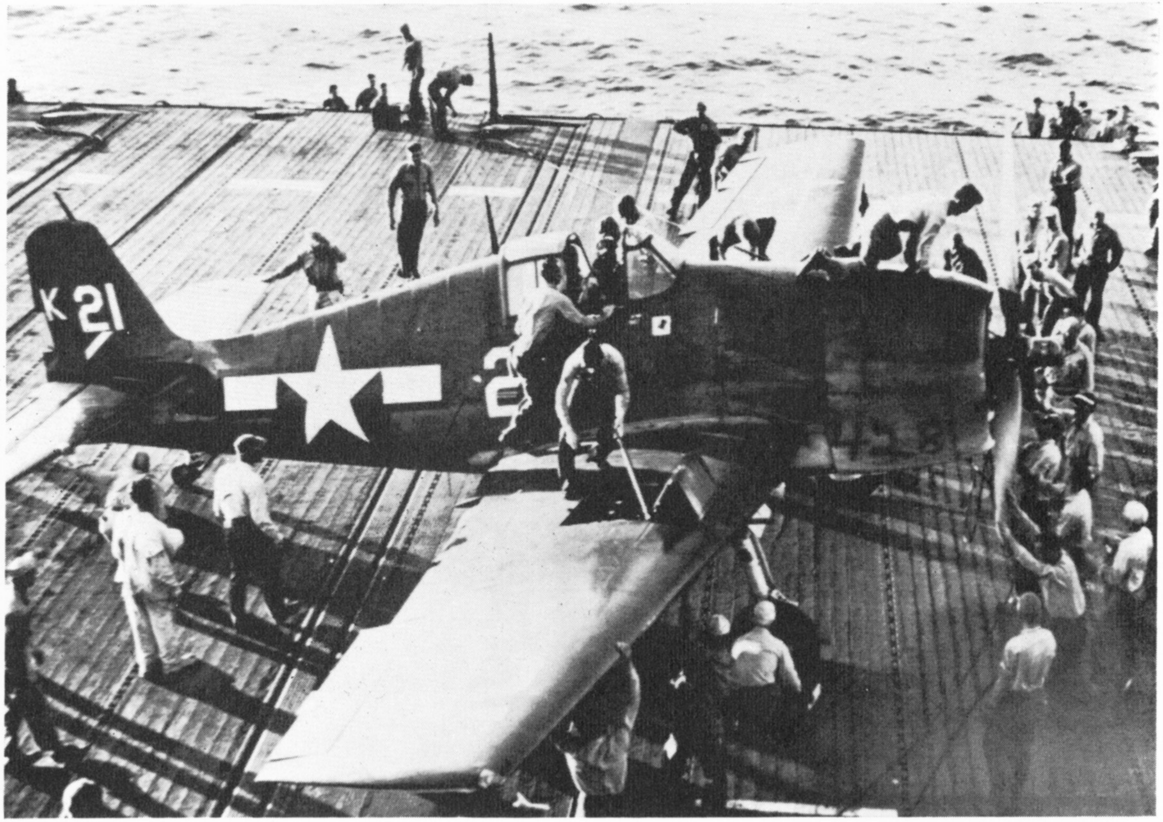
On August 31 1943 the U.S. Navy unleashed their new weapons when Task 51 launched their Hellcats from U.S.S. *Essex*, *Yorktown* and *Independence* against Japanese installations in the Marcus Islands. From then on the carrier-based F6F-3s took part in a series of strikes against Japanese bases designed to paralyse the Imperial Japanese Navy, whilst American amphibious forces landed successfully in the Solomons (New Georgia, Choiseul, Bougainville) and in the Gilbert and Marshall Islands (Tarawa, Makin, Roi, Namur). Providing escort for the U.S. carrier bombers and strafing Japanese ground installations, the Hellcats quickly asserted their superiority over the Mitsubishi A6M3s (HAMP) and A6M5s (ZEKE 52) and, amongst their pilots, Lt Eugene A. Valencia began to acquire a formidable reputation.

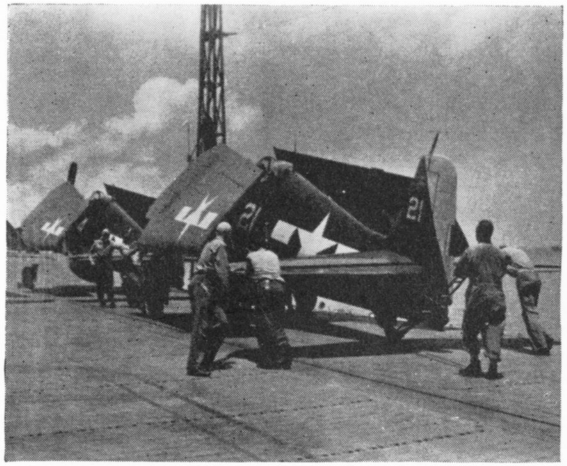
The Hellcats, during that period, were not confined to day operations, as in November 1943 a group of pilots, led by Lt-Cdr O'Hare, began to operate at night from the carrier *Enterprise*. Flying standard F6F-3s and operating under the guidance of radar-equipped TBF-1s, these pilots led the way to the latter use of F6F-3Ns and F6F-5Ns.

A section of F6F-5s ready for take-off from U.S.S. Randolph *(CV-15) laying off Ulithi Island, Ailerons were white, top and bottom.* [*A. G. Simmons, via F. Dial.*

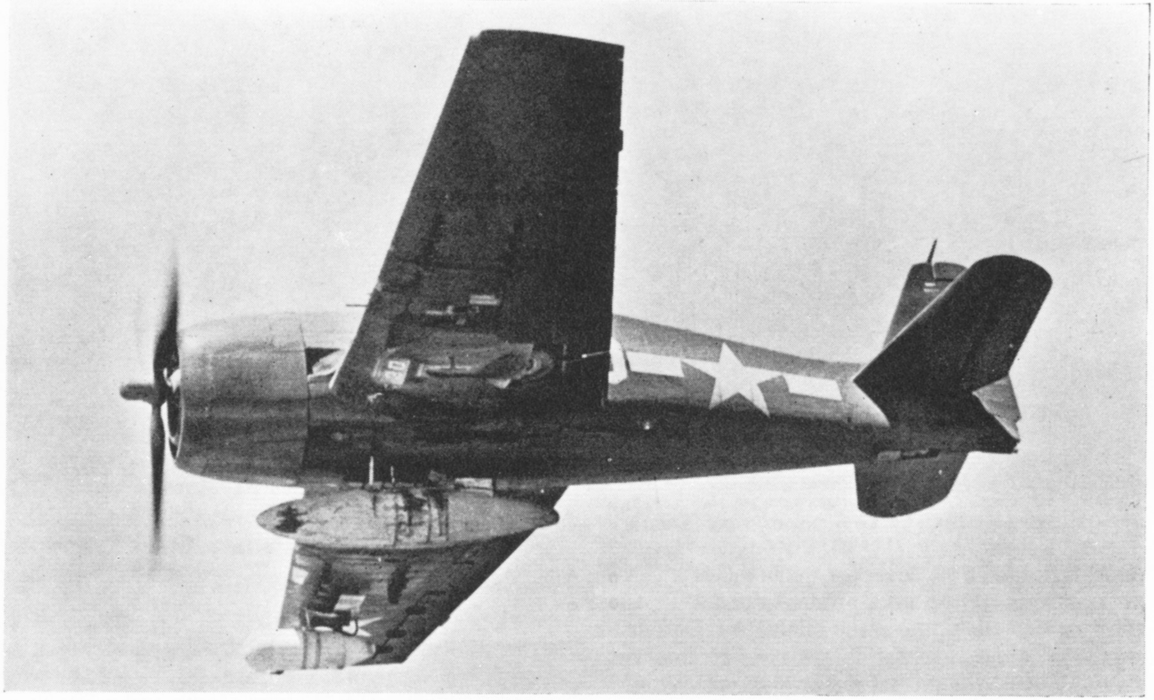


Deck crew getting ready to fold wings of an F6F-3 from VF-3 shortly after aircraft landed. [*U.S.N., via Francillon.*

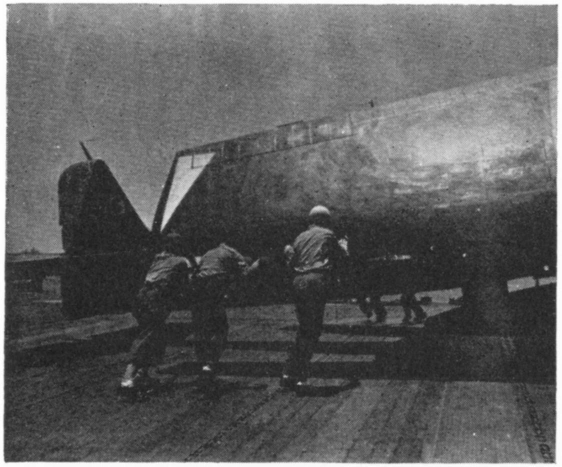




Aircraft with the 'G' system of carrier markings. These shown were of the Yorktown. *[A. G. Simmons, via F. Dial.*

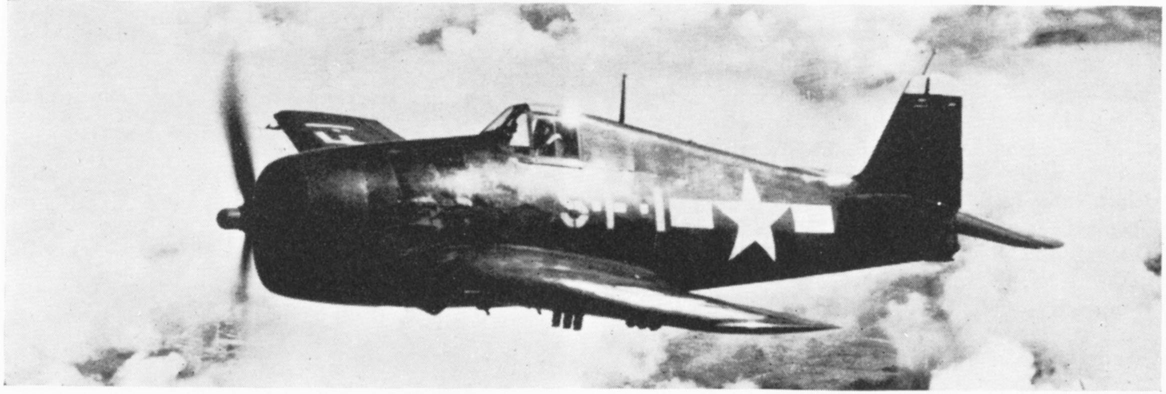


F6F-5 with electronic gear in pod under starboard wing and drop-tank on centre-line rack. [U.S.N., via Francillon.

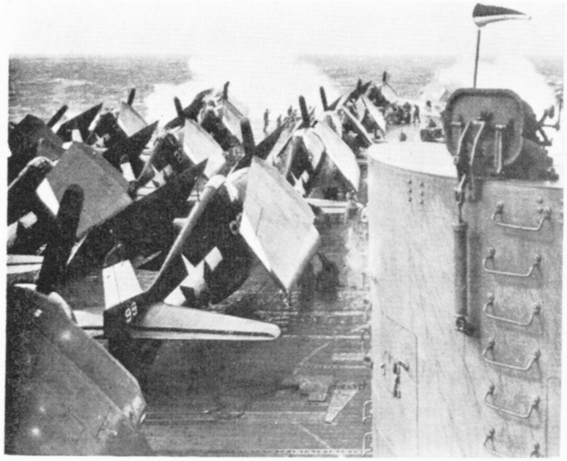


The Allied offensive slowly gained speed in early 1944 and Hellcats of Task Force 58 inflicting telling damage on Japanese land-based aircraft in a series of attacks. On February 17 and 18 1944 the F6Fs attacked Truk and destroyed 127 Japanese aircraft in the air and 86 on the ground. On March 29 and 30 they were over Palau and were credited with the destruction of some 150 enemy aircraft. However, the Hellcats' most celebrated contribution to the Allied war effort was their participation in the famous Mariana Turkey Shoot, during which some 400 Japanese carrier-based and land-based aircraft were destroyed, most of them by the magnificent F6Fs. Vectored by ship-borne radar the Hellcats surprised far at sea the Japanese aircraft taking part in the initial engagement on the morning of June 19 1944. Pouncing on their prey the F6Fs virtually annihilated the Japanese carrier-based aircraft in one engagement, and only 18 Japanese bombers managed to reach the U.S. fleet, losing two-thirds of these survivors to anti-aircraft guns. Their Hellcats having almost eliminated Japanese air opposition Task Force 58 went on to cruelly maul the Japanese fleet.

The Hellcats and the U.S. Navy continued to enjoy a series of remarkable successes, paving the road to Japan: air–sea battle of Formosa, October 12 and 14 1944; Second Battle of the Philippine Sea, October 24 and 25; Iwo-Jima; Okinawa. Finally, carrier-based



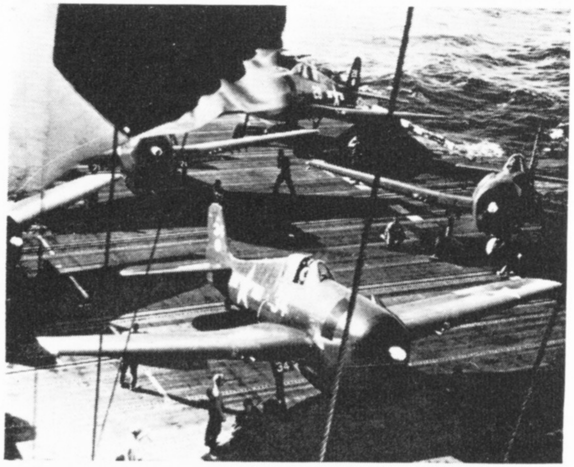
F6F-5 from VF-5 shortly after end of war when pre-war type unit identification markings were reintroduced. [U.S.N., via Francillon.

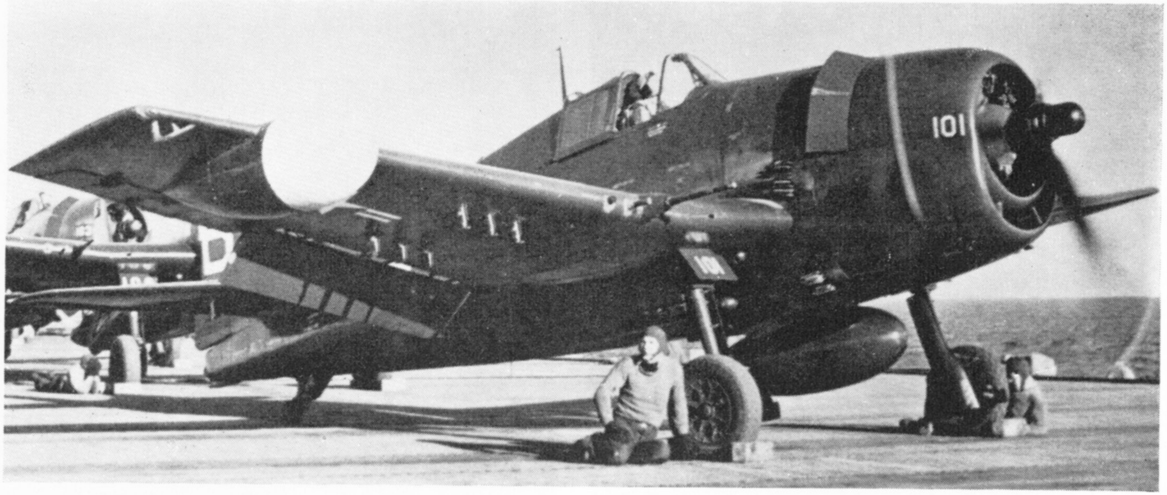


Rudder and wing 'G' system markings of the Lexington *(CV-16), February 1945. [A. G. Simmons, via F. Dial.*

Hellcats provided air cover for the bombers attacking the remnants of the once-proud Imperial Japanese Navy which were hiding in the Inland Sea. Despite the qualitative improvements of Japanese fighter aircraft, the absolescent Oscars and Zekes being supplanted by such types as the Franks, Jacks and Georges, the Hellcats continued to enjoy an unbroken streak of successes, as by then they had an overwhelming numerical superiority.

Glossy sea blue Hellcat with white dot fin marking of U.S.S. Hornet. *The F6F was the only aircraft to delete the insignia blue areas around the star and bars. This scheme became standard for all types painted sea blue in 1947. [A. G. Simmons, via F. Dial.*



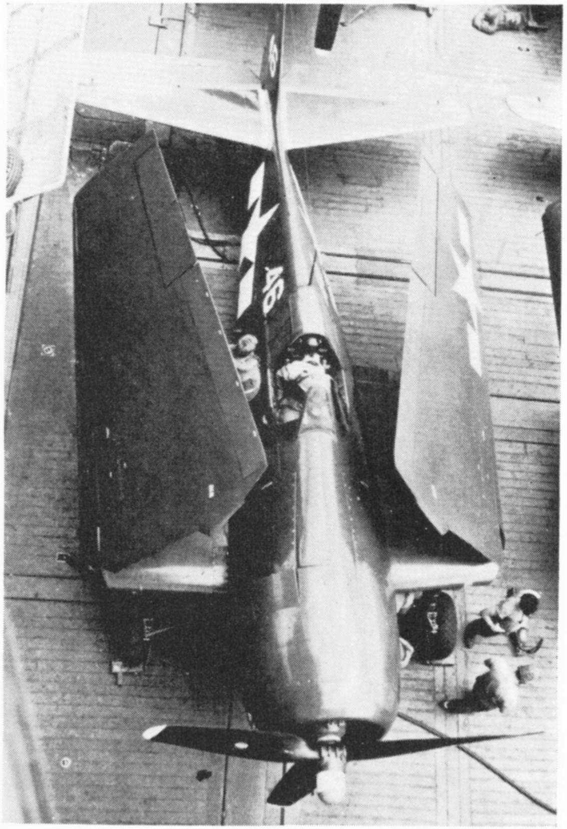


Above: F6F-5N aboard San Jacinto *(CVL-30), summer of 1945. Note 20-mm. cannon replacing the inboard .50-in. machine-gun. [U.S.N., via Francillon.*

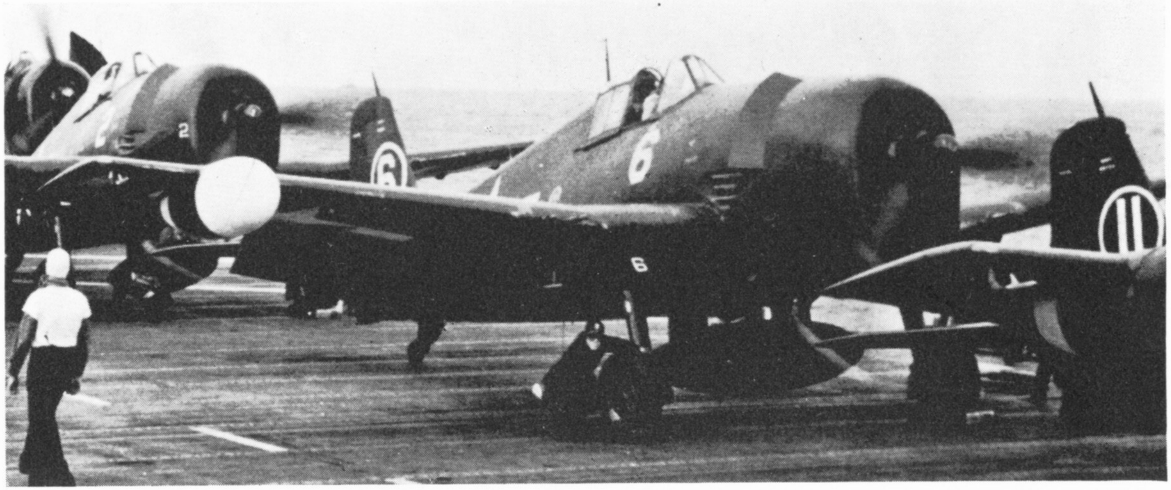
The Hellcats also saw action from land-bases but on a much smaller scale. Comparatively few F6Fs were operated by the U.S. Marine Corps and pilots from that Service, being less often limited by the constraints imposed by carrier operations, preferred the faster F4U Corsair to the more docile Hellcat. However, land-based Hellcats enjoyed considerable success in the night-fighting role and the F6F-5Ns were the most efficient night-fighter aircraft in the Pacific.

Many U.S. Navy pilots including the four top-ranking aces of that Service—Cdr David McCampbell (34 kills), Lt Cecil Harris (24 kills), Lt Eugene Valencia (23 kills) and Lt Alexander Vraciu (19 kills)—became famous whilst flying Hellcats. Cdr McCampbell, who led Air Group 15 of the U.S.S. *Essex* and was awarded the Congressional Medal of Honor, is remembered for destroying nine aircraft in a single engagement whilst flying an F6F-3, a remarkable tribute to both the pilot's marksmanship and the Hellcat's abundant supply of ammunition (400 r.p.g.) Lt Valencia, having destroyed seven Japanese aircraft during a first tour of duty whilst the Hellcat was making its combat début, came back for a second tour of duty in 1945. Operating as a team with Lts (jg) James French, Harry Mitchell and Clinton Smith, Lt Valencia added 16 victories to his score whilst his team-mates were respectively credited with 11, 10 and 6 kills for a total of fifty enemy aircraft destroyed by this highly effective quartet.

Below: The characteristic Grumman wing-folding system is clearly shown on this view of an F6F-5. [U.S.N., via Francillon.



'G' system markings of the Saratoga (CV-3), February 1945. Note unusual position of fuselage number. [*via F. Dial.*



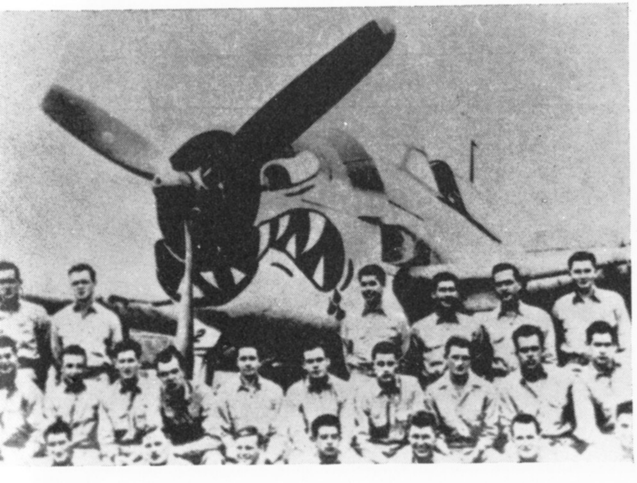
Above: F6F-5 Hellcat aboard the Hornet *in early 1945.* [*U.S.N., via Francillon.*

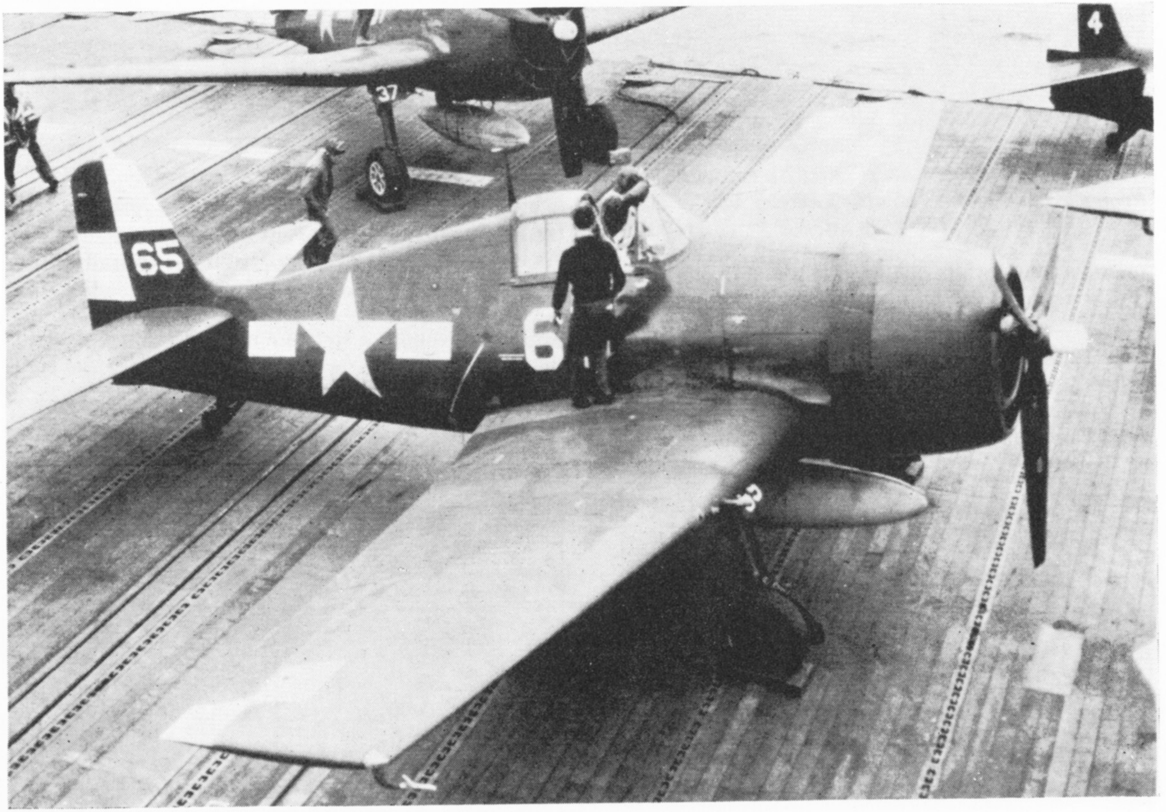
Below: F6F-5N Night Fighters of VF(n)-41 aboard the Independence *(CVL-22) in October 1944.* [*U.S.N., via Francillon.*

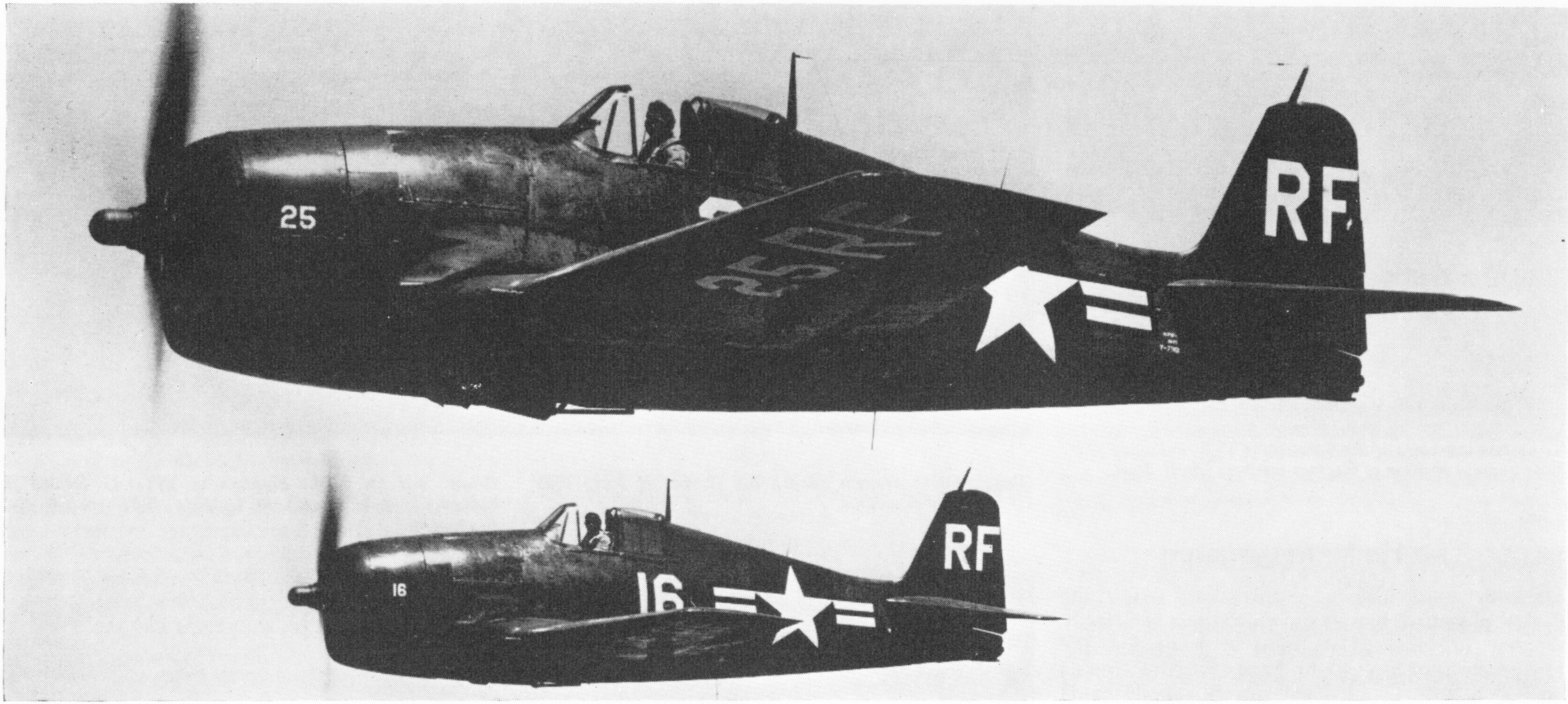
The Hellcat evaluated

Markedly slower than the contemporary F4U-1, the Hellcat possessed, however, performances sufficiently superior to those of its most frequent foe—the Mitsubishi Zero-Sen—to be highly effective. It was immensely strong and could survive serious battle damages and it was uncomplicated and easy to maintain. It was well armed and well protected but,

Shark-mouth markings of VF-21 aboard the Princetown *CVL-23).* [*F. Smith, via F. Dial.*







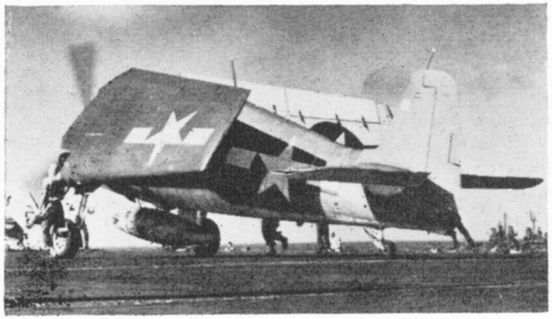
Grumman F6F-5s of a U.S. Navy reserve unit in the late '40s. [*Grumman, via Francillon.*

foremost amongst its qualities, it was a docile aircraft ideally suited to carrier operations.

As there is no better method of evaluating the effectiveness of a fighter aircraft than to use the kill-to-loss ratio, it is interesting to note that the Hellcat achieved a ratio of nineteen to one, whilst the ratio for the much-vaunted Corsair was 'only' eleven to one. As a further point of comparison the overall kill-to-loss ratio for the U.S. Navy increased steadily from 3.2 to one in 1941–2 to 21.6 to one in 1945, the average throughout the war being 10.2 to one. Thus the Corsair was barely above average whilst the Hellcat made a very significant contribution to the success of the U.S. Navy in the air.

The Hellcat could never earn a prize for aerodynamic cleanliness or beauty but it was truly a most successful and efficient beast, and who could say that, for a fighter aircraft, beauty is more important than efficiency?

An F6F warming up aboard the Lexington, *November 1943.* [*A. G. Simmons, via F. Dial.*



Specification	F6F-3	F6F-3N	F6F-5	F6F-5N	XF6F-6
Span, ft. in.	42 10	42 10	42 10	42 10	42 10
Length, ft. in.	33 7	33 7	33 7	33 7	33 7
Height, ft. in.	13 1	13 1	13 1	13 1	13 1
Wing area, sq. ft.	334	334	334	334	334
Empty weight, lb.	9,101	9,331	9,238	9,421	9,526
Loaded weight, lb.	12,441	13,015	12,740	13,190	12,768
Maximum weight, lb.	15,487	14,074	15,413	14,250	13,823
Wing loading, lb./sq. ft.	37.2	39.0	38.1	39.5	38.2
Power loading, lb./h.p.	6.2	6.5	6.4	6.6	6.1
Maximum speed, m.p.h./ft.	375/17,300	360/18,000	380/23,400	366/23,200	417/21,900
Cruise speed, m.p.h./ft.	160	161	168	166	171
Climb rate, ft./min.	3,500/1	3,090/1	2.980/1	2,840/1	3,070/1
Service ceiling, ft.	37,300	38,100	37,300	36,700	39,000
Normal range, miles	1,090	865	945	880	1,170
Maximum range, miles	1,590	1,235	1,355	1,260	1,730
Power plant	R-2800-10W	R-2800-10W	R-2800-10W	R-2800-10W	R-2800-18W
T.O. rating, h.p.	2,000	2,000	2,000	2,000	2,100
Maximum rating, h.p./ft.	1,975/16,900	1,975/16,900	1,975/16,900	1,975/16,900	1,800/21,900
Armament	6×0.50 in.	6×0.50 in.	6×0.50 in. 2,000-lb. bomb	6×0.50 in.	6×0.50 in.

Lockheed P-38 Lightning

During the war scant and derogatory information on Allied aircraft was found in the German-controlled Press of the occupied nations on the European continent. Yet some of these aircraft soon found a very special place in the minds of the populace and, with the Spitfire, the Lightning was the best-known Allied aircraft until more information became available following the liberation. 'Le double queue' (the twin-tailed one), as the P-38 was known to the French and the Walloons, became a symbol of hope in the dark days between June 1940 and June 1944. Indeed the Lightnings and their pilots did much to justify this hope.

Oddly enough the P-38, which gained its fame as a long-range fighter, stemmed from a 1936 Army Air Corps requirement for a pursuit-interceptor capable of reaching 360 m.p.h. at 20,000 ft. and possessing an endurance of one hour at full throttle at this altitude. To meet this stringent requirement, a design team led by H. L. Hibbard and C. L. Johnson was organised by Lockheed. From the onset of their work this team studied a series of highly unconventional twin-engined designs, including two with engines buried in the fuselage and driving respectively wing-mounted pusher and tractor propellers, a twin-boom design with engines mounted fore and aft of the pilot in a central nacelle (i.e. *à la* Fokker D.XXIII), another twin-boom design with cockpit installed in the port boom and a more conventional twin-engined design with cockpit and armament mounted in a central nacelle.* Calculated performances well exceeded the requirements of the Army Air Corps (top speed at 20,000 ft.: 417 m.p.h. versus 360 m.p.h.) and, on June 23 1937, Lockheed was awarded a contract for a XP-38 prototype.

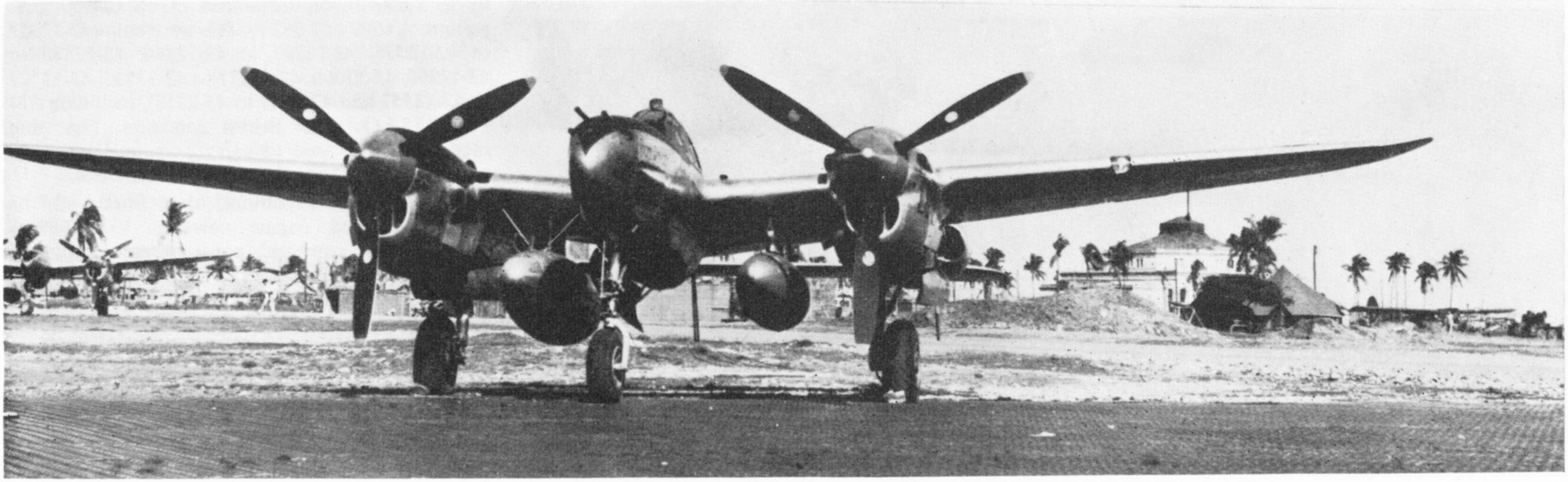
Powered by a pair of Allison V-1710-11/-15 liquid-cooled engines, the XP-38 (37-457) was fitted with a General Electric turbo-supercharger in each boom and had a tricycle retractable undercarriage. Armament, not installed, was to include one 23-mm. Madsen cannon and four 0.50-in. machine-guns mounted in the extreme nose of the central nacelle. On January 27 1939, at March Field, California, the aircraft made its maiden flight marred only by the failure of a flap linkage, and within two weeks the aircraft was considered ready for delivery to Wright Field, Ohio. It was then decided to combine the delivery flight with an attempt to break the transcontinental speed record. On February 11 1939, the XP-38, piloted by Lt B. S. Kelsey, took off from March Field, California, for Mitchell Field. After two fuelling stops at Amarillo, Texas and Wright Field, Ohio, and 7 hrs. 2 min. of flying time the aircraft arrived at Mitchell Field. Unfortunately, Lt Kelsey was over-tired and missed his first approach. After applying power too quickly to go around, one of the engines faltered and the XP-38 ended in a crash-landing.

Despite this unfortunate accident the aircraft had demonstrated spectacular performance, and thirteen pre-production YP-38s were ordered by the Army Air Corps on April 27 1939, whilst on August 10 1939 a first production contract was awarded to Lockheed. The future of the P-38 was assured.

Lightning development

YP-38: Thirteen pre-production aircraft (39-689 to 39-701) powered by two V-1710-27/29 with outwardly rotating propellers instead of inwardly rotating units as on the XP-38. Modified cowling and larger radiators on sides of booms. Armament modified to include one 37-mm. cannon and two 0.50-in. and two 0.30-in. machine-guns. First flown on September 16 1940, with deliveries completed in June 1941. Normal loaded weight reduced by 1,300 lb. to 13,500 lb.

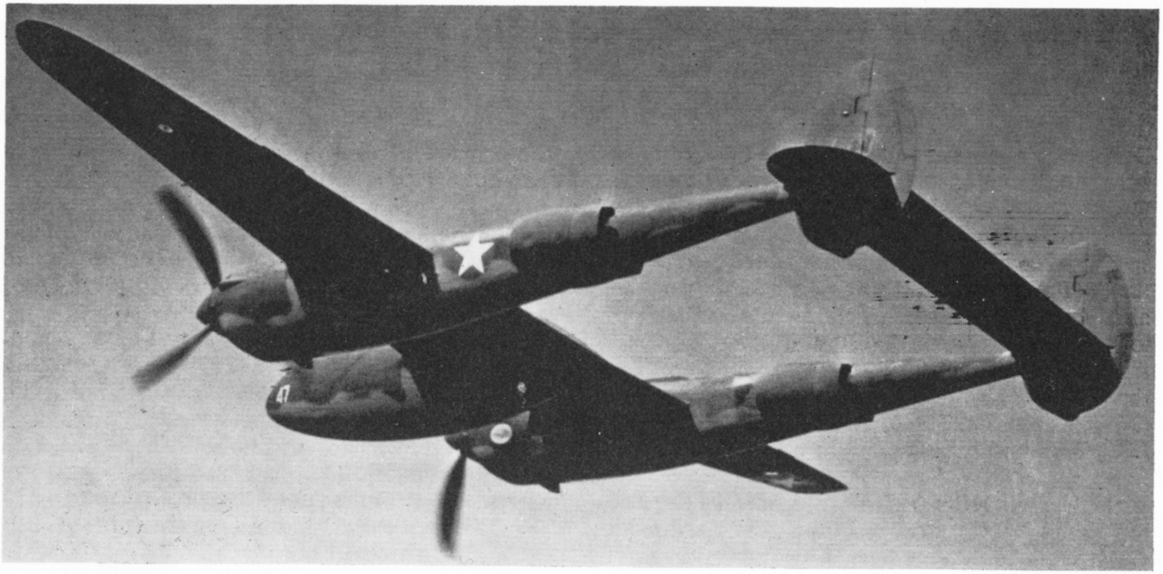
P-38L of Major McGuire's unit, the 475th Fighter Group. Carrying 310 and 165 U.S. gallon drop tanks, the aircraft is seen at Lingayen, August 25 1945. [U.S.A.F., via Francillon.



---

* *Finally Lockheed selected their Model 22, a twin-boom design with cockpit and armament mounted in a central nacelle.*

Lockheed P-38G in early scheme on August 15 1942. [Harry Gann, via Francillon.



P-38: First production batch of thirty aircraft (40-744 to 40-773). Similar to YP-38 except for minor details and armament of one 37-mm. cannon and four 0.50-in. machine-guns. One aircraft (40-744) fitted with a second cockpit on port boom and designated RP-38.

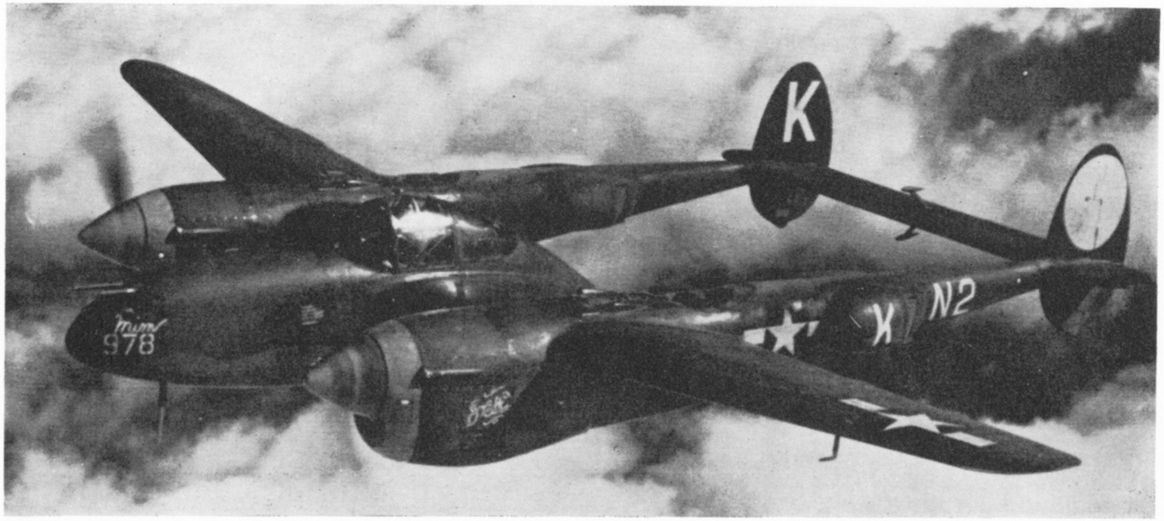
XP-38A: One P-38 (40-762) experimentally fitted with a pressurised cockpit.

P-38B and P-38C: Designations not assigned.

P-38D: Last thirty-six aircraft of first contract (40-774 to 40-809) completed to full 'combat-worthy' standard with the addition of self-sealing tanks and various minor aerodynamic changes. Cannon changed to 23 mm. Madsen type.

P-38E: Still retaining the V-1710-27/29 first used on the YP-38s were the 210 P-38Es (41-1938 to 41-2097, 41-2100 to 41-2120, 41-2172, 41-2219 and 41-2221 to 2292). Further equipment changes and heated gun-bay, housing one 20 mm. cannon and four 0.50-in. machine-guns. This armament became standard on all production P-38s. The P-38E was the last model of the Lightning not to be approved by the Army Air Forces for combat operations. Ninety-nine additional aircraft completed as F-4 photo-reconnaissance aircraft. Experimental modifications included the fitting, on 41-2048, of experimental aerofoils of increased chord and of an elongated nacelle with two-seat cockpit, and the use on 41-1986 with a raised tail in an attempt to solve compressibility problems.

P-38J of the 383rd Fighter Squadron, 364th Fighter Group, 67th Fighter Wing, 8th Air Force, at the time of the initial raids over Berlin. [U.S.A.F., via Francillon.

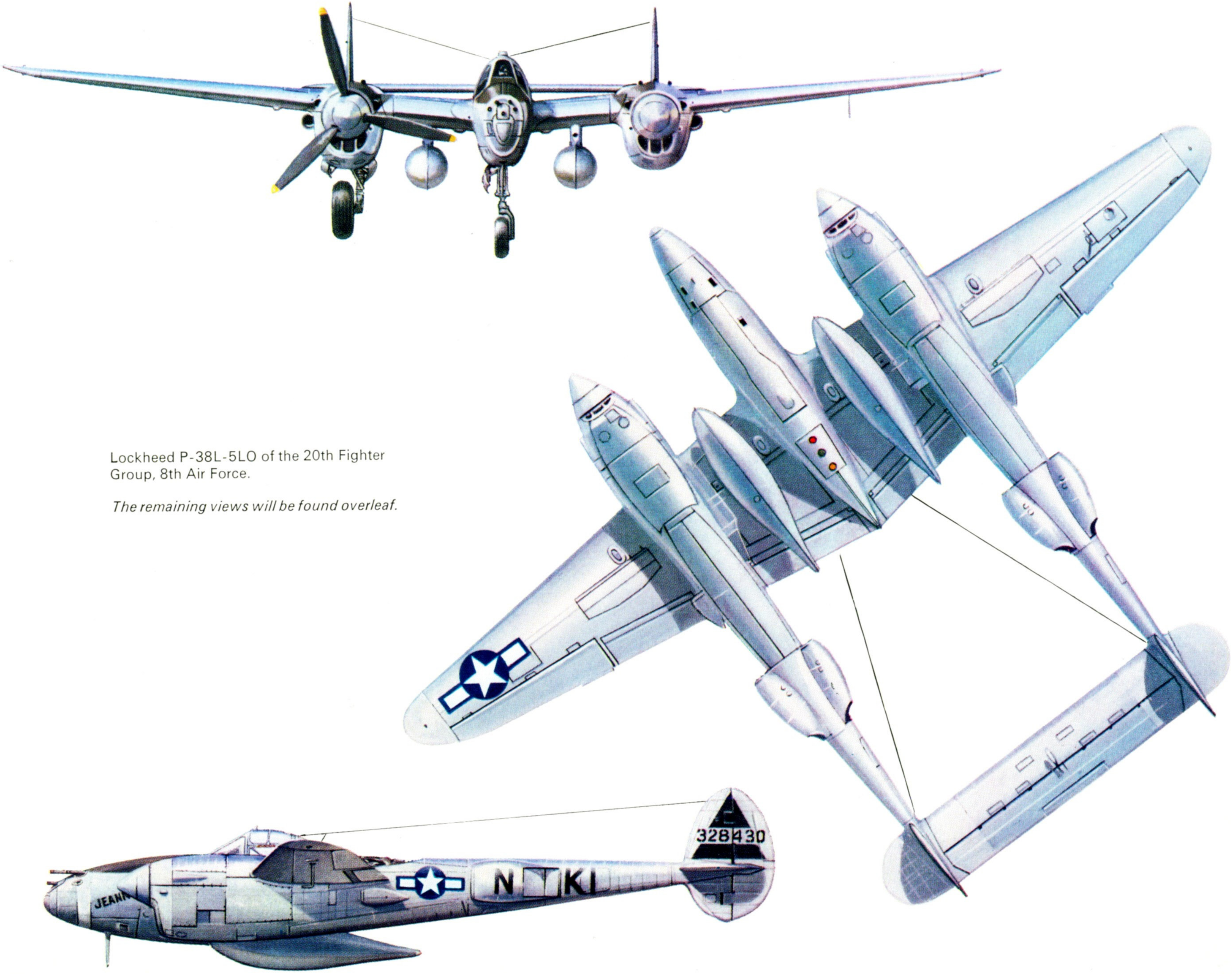


P-38F: First Lightning variant accepted for combat operations. Deliveries of 527 P-38Fs (41-2293 to 41-2361, 41-2382 to 41-2392, 41-7484 to 41-7680, 41-12567 to 41-12569, and 43-2035 to 43-2184), including 150 aircraft originally ordered for the R.A.F. by the British Purchasing Commission. Two V-1710-49/53 with take-off rating increased from 1,150 h.p. to 1,325 h.p. Wing racks fitted for two 1,000-lb. bombs or two 75 or 150 U.S. gallon drop-tanks. On the last 121 aircraft (p-38F-15-LO) the Fowler flaps could be lowered 8° in combat to tighten turns. Experimental installation of two torpedoes on 43-2035 and first installation of ski-undercarriage and artic equipment on another aircraft of this batch. Some aircraft were fitted with 'jump-seat' behind pilot for pilot familiarisation.

P-38G: Refinement of previous model powered by two V-1710-51/55 engines with increased military power rating. Strengthened inner wing racks for bombs of up to 1,600 lb. or drop-tanks of up to 300 U.S. gallons. A total of 1,082 P-38Gs were built (42-12687 to 42-12766, 42-12787 to 42-12866, 42-12870 to 42-12966, 42-13066, 42-13127 to 42-13266, 42-13327 to 42-13557 and 43-2185 to 43-2558), including 374 P-38G-15-LOs from British contracts. The wing racks could be used to carry personnel-container with accommodation for two stretcher-cases.

P-38H: Last of the Lightnings to be fitted with the original tapered engine cowling. V-1710-89/91 engines with improved supercharger. Improved 20-mm. cannon. Deliveries of 601 P-38Hs (42-13559 and 42-66502 to 42-67101).

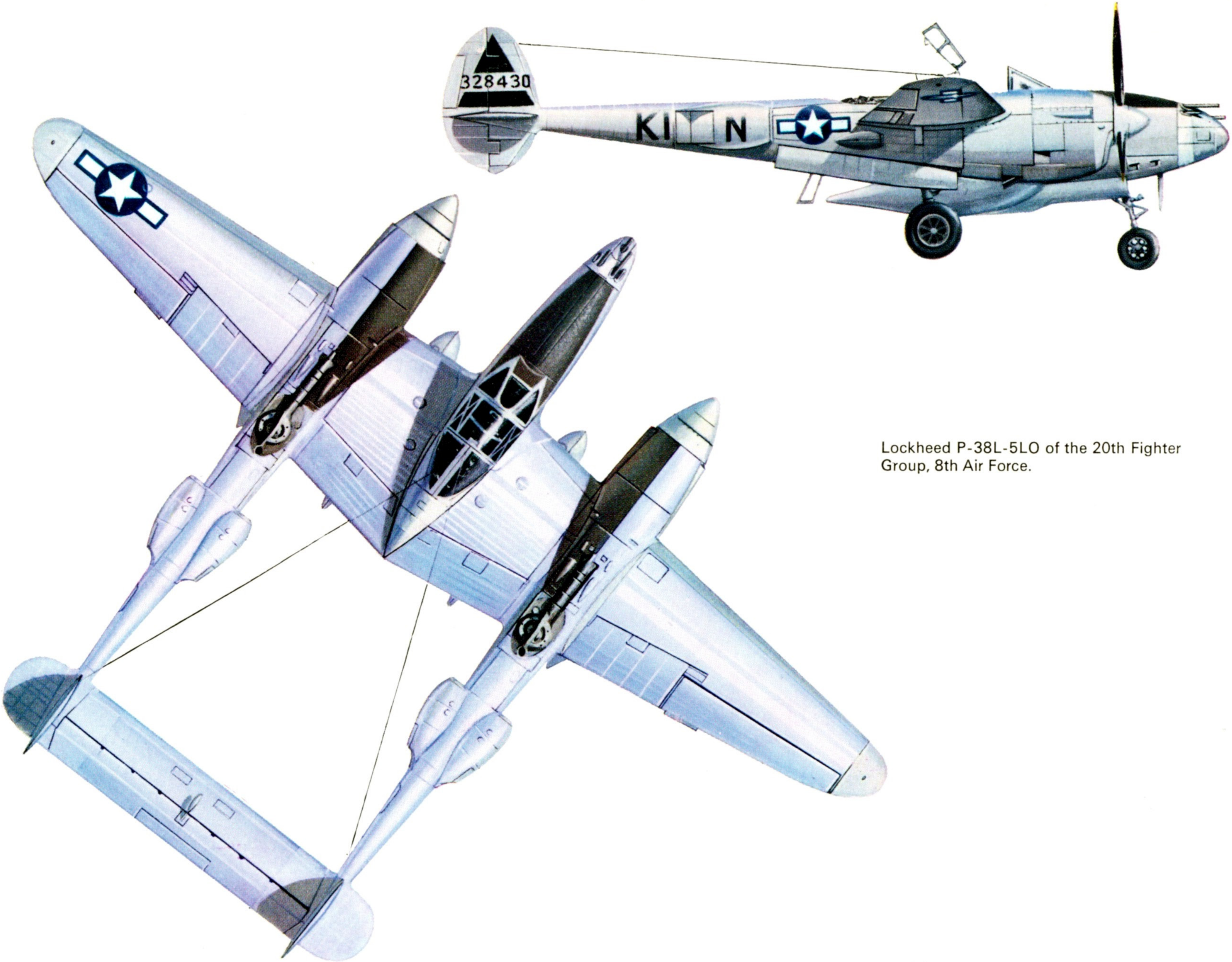
P-38J: With this model the external appearance of the Lightning underwent a drastic change as the intercoolers were removed from inner wing leading edges and larger units installed under the spinners. The removal enabled the installation on some of the early P-38Js of leading-edge tanks increasing internal tankage from 300 to 410 U.S. gallons. Once a


328430
N KI
JEANN

Lockheed P-38L-5LO of the 20th Fighter Group, 8th Air Force.

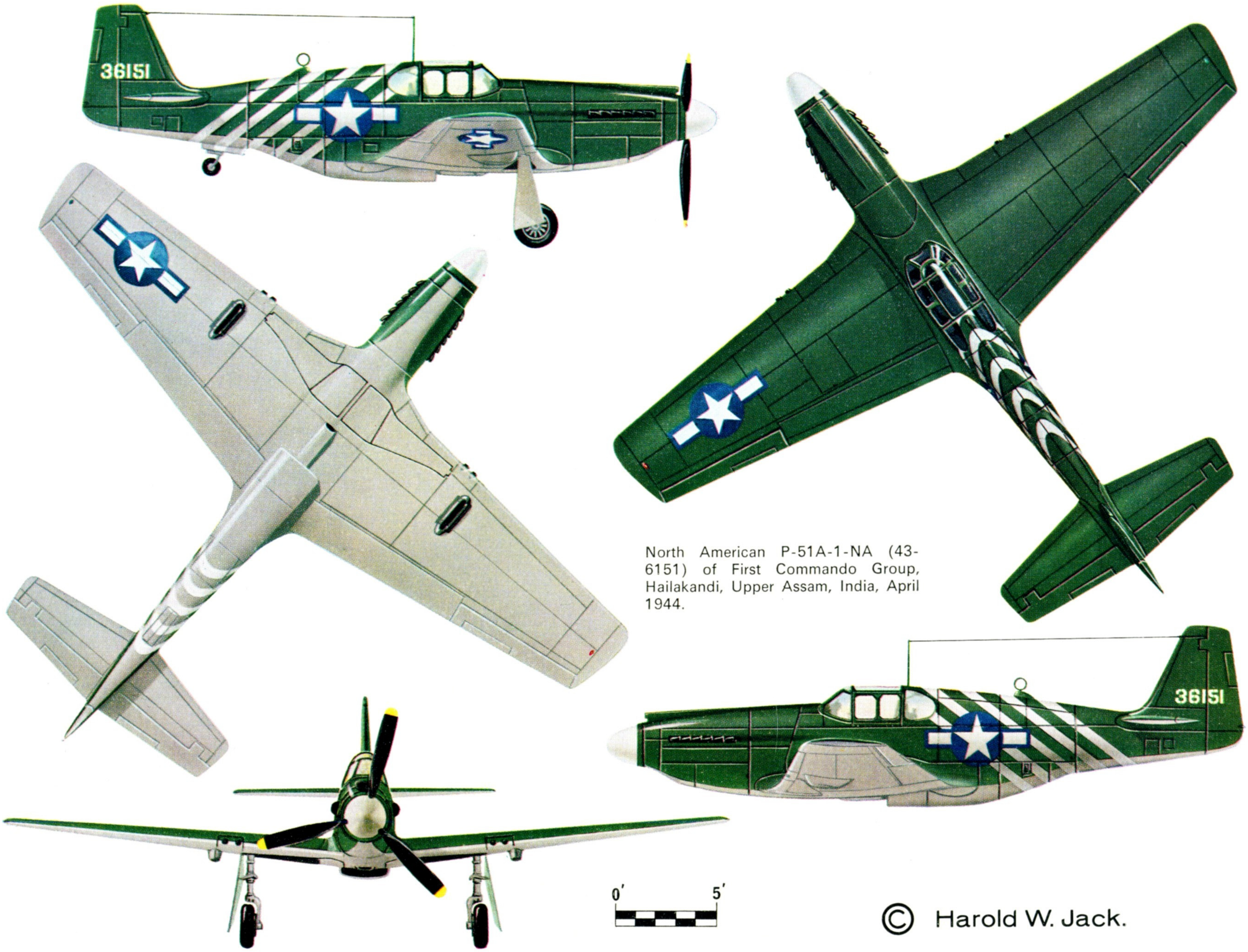
The remaining views will be found overleaf.

AFI/CC



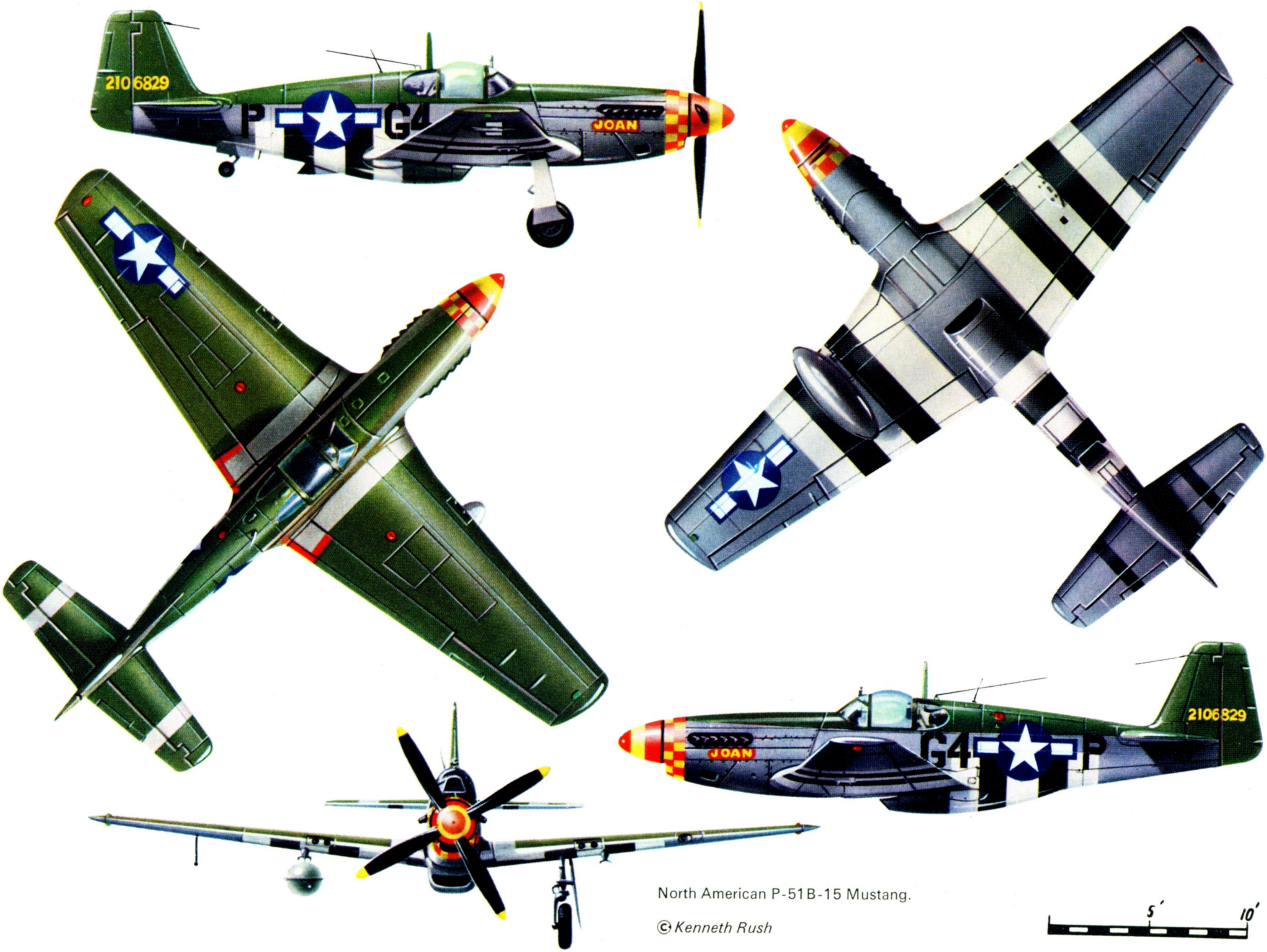
Lockheed P-38L-5LO of the 20th Fighter Group, 8th Air Force.

© JOHN YOUNG M.S.I.A.


36151
36151
0′
5′

North American P-51A-1-NA (43-6151) of First Commando Group, Hailakandi, Upper Assam, India, April 1944.

© Harold W. Jack.


2106829
P
G4
JOAN
G4
P
2106829
5'
10'

North American P-51B-15 Mustang.

© *Kenneth Rush*

Colourful P-38L believed to have been photographed in the Pacific. [*Harry Gann, via Francillon.*

buckling tendency on the wing surface over the tanks was eliminated by fitting a strip of heavy-gauge metal, these tanks were adopted as standard on the P-38J-15-LO and subsequent blocks. The P-38J retained the P-38H's V-1710-89/91 engines but improved cooling enabled to increase war emergency power from 1,240 h.p. to 1,425 h.p. Several internal equipment changes were introduced on this model and a new optically flat bullet-proof windshield was installed, whilst commencing with the P-38J-25-LOs the aircraft were fitted with retractable drive brakes beneath the outer wing panels and an hydraulic aileron booster system. A number of P-38Js (and P-38Ls) were fitted with a transparent nose accommodating a bombardier operating a Norden sight for use in 'follow-the-leader' level bombing operations, with standard Lightnings carrying bombs on wing racks. Later some aircraft were fitted with a plexiglas and aluminium nose, housing a radar bomb-sight. A total of 2,970 P-38Js were built (42-12867 to 42-12869, 42-13560 to 42-13566, 42-67102 to 42-67311, 42-67402 to 42-68191, 42-103979 to 42-104428, 43-28248 to 43-29047 and 44-23059 to 44-23768.)

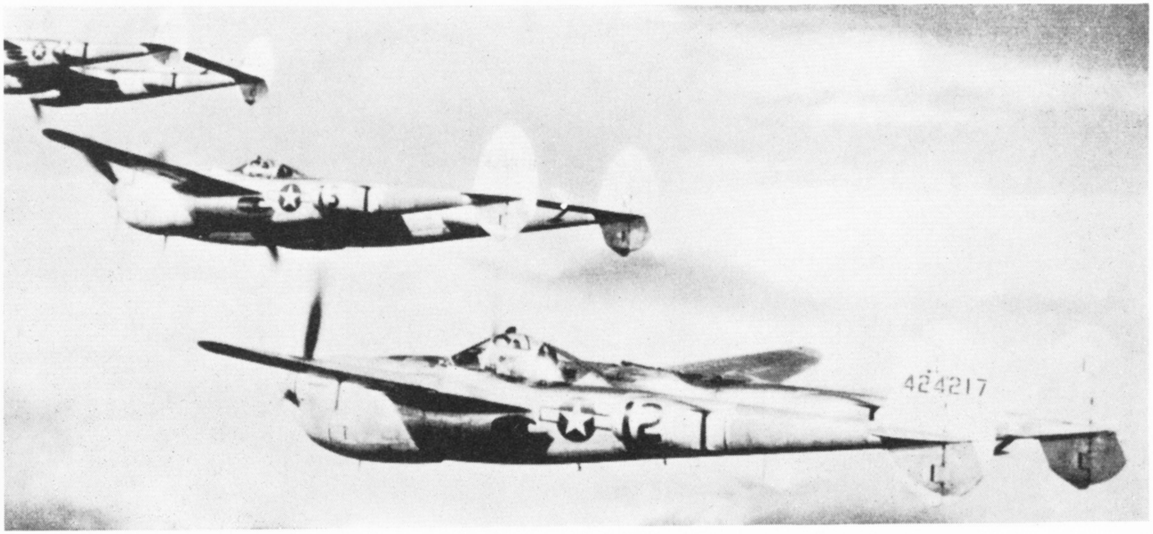
XP-38K: One experimental high-altitude aircraft modified from a P-38E (41-1983) powered by a pair of V-1710-75/77 engines driving wide blade propeller with a diameter increased by 1 ft. Serial officially changed to 42-13558 but not changed on the aircraft.

P-38L: Final production model of which 3,810 were built by Lockheed (44-23769 to 44-27256 and 44-53008 to 44-53327) and 113 P-38L-5-VNs were built by Consolidated-Vultee at Nashville, Tennessee (43-50226 to 43-50338). Characterised externally by the installation of a landing light in the port wing leading edge, the P-38Ls were powered by two V-1710-111/113 engines with a maximum War Emergency rating of 1,600 h.p. at 28,700 ft. Following experimental installation of bazooka-type rocket launchers under the central nacelle of earlier P-38 series, the P-38Ls were fitted with H.V.A.R. rockets on zero-length launchers. Initially seven projectiles were mounted directly under each wing but this installation was later replaced by 'tree'-type rocket launchers, each carrying five 4-in. or 5-in. rockets, one launcher being installed under each wing. Experiments carried with P-38Ls included the testing of three 0.60-in. machine-guns in the nose of 44-23601 whilst 44-24649 was tested as a ground strafer with twelve 0.50-in. machine-guns (eight in the nose and four in two underwing pods). Neither was accepted for production but several P-38Ls were modified in the field as 'pathfinders' with either bombardier nose or radar bomb sight.

P-38M: Two-seat night-fighter version modified from existing P-38L-5-LO airframes and retaining the standard armament and engines of these aircraft. Radar hung externally forward of the nose gear and radar-operator's seat mounted just behind the pilot's seat under raised canopy.

P-322: In April 1940 the British Purchasing Commission ordered 143 Lightning Is (R.A.F. serials AE978 to AF220). Airframes similar to that of the P-38D but powered by V-1710-C15s with turbo-superchargers replaced by mechanically driven superchargers. Without turbo-superchargers the aircraft lacked the altitude performances of the Army Air Corps version and the Royal Air Force did not accept the type for service operation. Most aircraft built, retaining their British serial numbers and camouflage, were impressed as P-322s by the Army Air Forces as fighter trainers, and twenty of these had a jump-seat installed behind the pilot's seat.

F-4: Unarmed photo-reconnaissance version of the P-38E of which 99 (41-2098, 41-2099, 41-2121 to 41-2156, 41-2158 to 41-2171, 41-2173 to 41-2218 and 41-2220) were built by Lockheed. Four K-17



Formation of P-38L-1-LOs of the 28th Fighter Squadron, 1st Fighter Group, 15th Air Force, Italy, 1944. [*U.S.A.F., via Francillon.*

cameras in the nose. Antenna mast moved from underneath the nose to its top.

F-4A: Generally similar photo-reconnaissance version of the P-38F of which 20 (41-2362 to 41-2381) were built by Lockheed.

F-5A: A total of 181 photo-reconnaissance aircraft of this type were built by Lockheed and were powered by a pair of V-1710-51/55 engines. All had an identical camera installation but one (41-2157) had an airframe similar to that of the P-38E, twenty aircraft (42-12667 to 42-12686) had P-38F type air-frames and the remaining 160 F-5As (42-12767 to 42-12786, 42-12967 to 42-12986, 42-13067 to 42-13126 and 42-13267 to 42-13326) had airframes similar to those of the P-38Gs.

Up to and including the F-5As the photo-reconnaissance Lightnings had engine installation similar to that of the XP-38 to P-38H fighter variants.

F-5B: This was the last version of the photo-reconnaissance Lightning to be built as such on Lockheed's assembly lines, and 200 were built. Powered by V-1710-51/55 engines with chin-type radiator *à la* P-38J. Airframes were similar to the P-38H on the first 90 aircraft (42-67312 to 42-67401) and to the P-38J on the last 110 aircraft (42-68192 to 42-68301).

F-5C: After completion, 128 P-38Js were modified by Lockheed at their Dallas Modification Centre to photo-reconnaissance configuration. The F-5Cs retained the original P-38J serial numbers and engine installation but all armament was removed and cameras installed in the nose.

XF-5D: One F-5A (42-12795) modified at Dallas as a two-seat armed reconnaissance aircraft. First Lightning to feature glazed nose with forward seat. Two 0.50-in. machine-guns mounted on the sides of the observer seat.

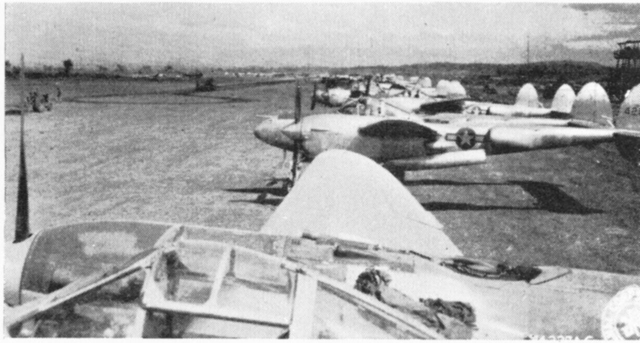
F-5E: New camera installation in the nose of 205 P-38Js (V-1710-89/91 engines) and 508 P-38Ls (V-1710-111/113s) modified at the Dallas Modification Centre.

F-5F: Unspecified number of V-1710-111/113-powered P-38Ls modified at Dallas. Details not available.

F-5G: Final photo-reconnaissance version of the Lightning using P-38L airframes and power plants married to an extensively modified nose with improved cameras.

FO-1: Designation applied to a number of F-5Bs acquired by U.S. Navy in North Africa. BuNos. recorded include 01209 to 01212.

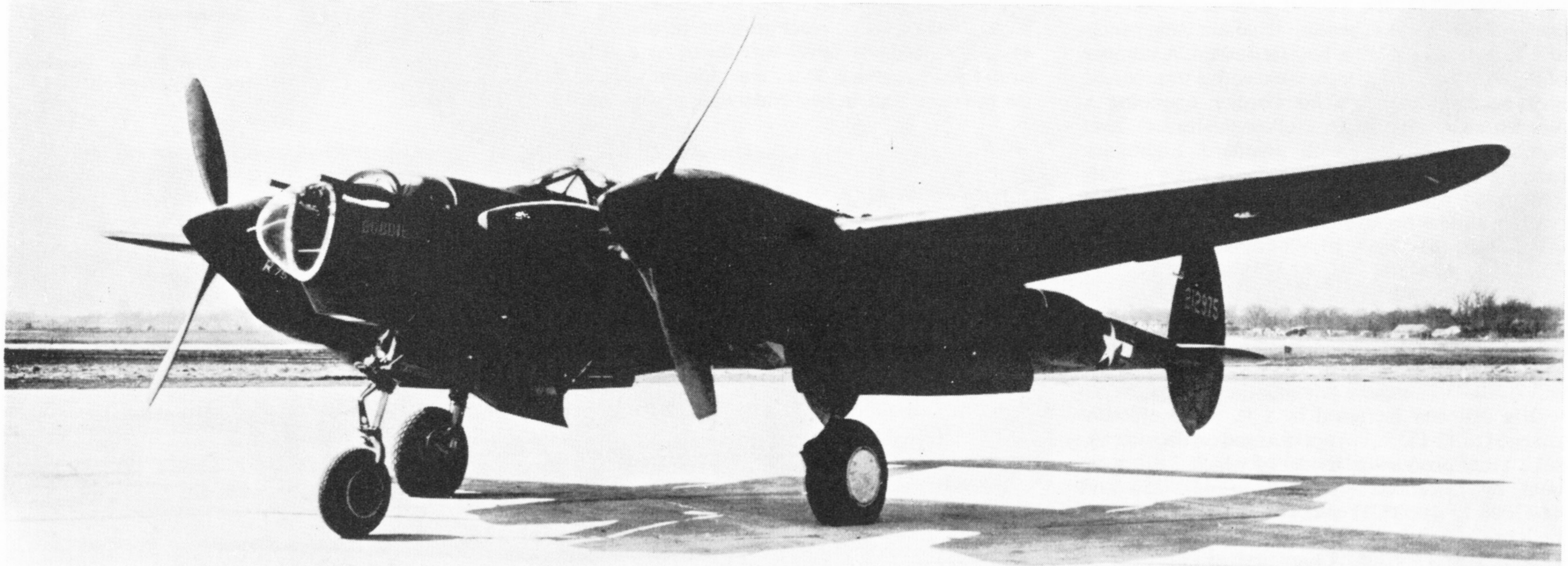
Following the Japanese surrender a substantial number of Lightnings on order with both Lockheed and Consolidated-Vultee were cancelled and total production obtained 9,923 aircraft (9,280 XP-38 to P-38L—including F-5C to F-5G conversions—143 Lightnings I and 500 F-4s, F-4As and F-5Bs).



Hill Fighter Strip, Mindoro, December 20 1944. Line-up of P-38L5-LOs of the 36th Fighter Squadron, 8th Fighter Group, 5th Air Force. [*U.S.A.F., via Francillon.*

Service history

Development of the large and complex Lockheed fighter required considerable time, and the first production P-38 was not delivered to the then new



Lockheed XF-5D, two-seat photo-reconnaissance aircraft. Note muzzles of twin 0.05-in. machine guns. [*Lockheed, via Francillon.*

Army Air Forces until June 1941, some twenty-eight months after the first flight of the XP-38 and nine months after the initial flight of the YP-38. Yet once production had been organised deliveries were made at an accelerated rate with the first P-38D and P-38E being respectively accepted in August and October 1941.

The first operation unit to receive a mixed batch of P-38s, P-38Ds and P-38Es was the 1st Pursuit Group at Selfridge Field, Michigan, followed by the 14th Pursuit Group at March Field, California. Training proceeded slowly and was marred by several unfortunate accidents. Thus, when Japan struck, neither the 1st nor the 14th Groups were combat-ready but, like so many other ill-equipped, ill-trained units, they took part in the disorganised efforts to counter a potential Japanese attack against the continental United States.

The war accelerated the tempo of re-equipment, and with the availability of the P-38Fs the Army Air Forces at last possessed a high-performance combat aircraft for deployment overseas. Appropriately enough the 1st Fighter Group (formerly 1st Pursuit Group) obtained a number of firsts: first fighter unit to fly its aircraft over the North Atlantic ferry route, first P-38 unit to arrive in England, first P-38 confirmed 'kill' (a FW 200C shot down by Lt Elza Shahan of the 27th Fighter Squadron whilst on detachment in Iceland), first P-38 combat sorties over German-occupied territories on August 28 1942, and first P-38 deployed to North Africa, where they began combat operations on November 13 from Tafaroui, Algeria. Also equipped with P-38Fs the 14th Fighter Group followed within a few days in the footsteps of the 1st Fighter Group and, by early December 1942, both groups where reinforced by a third P-38 unit: the 82nd Fighter Group. All three units flew escort, strafing, visual reconnaissance and anti-shipping missions with creditable successes as soon as the crews had learned to take advantage of the speed and zoom performances of their aircraft. As the Axis forces retreated the three P-38 groups moved to Tunisia, Sicily, and finally to Italy. In these various sectors they were joined by two other units equipped with Lightnings, although of the unarmed photo-reconnaissance variants (F-4s and F-5s): the 3rd and 5th Reconnaissance Groups. Upon arriving in North Africa these units has been assigned to the Twelfth Air Force but, with the exception of the 3rd Reconnaissance Group, they were reassigned in Italy to the Fifteenth Air Force. Within this new organisation the 1st, 14th and 82nd Fighter Groups operated essentially in the bomber escort role, particularly during B-17 shuttle-type operations, and, on June 10 1944, the 82nd Fighter Group distinguished itself during a dive-bombing attack on the celebrated Ploesti oil-refinery in Romania.

P-38 operations in Europe were not limited to actions in the south as, following the brief operations from England by the 1st and 14th Fighter Groups, other Lightning units were assigned to the Eighth Air Force in England. Space prevents us from detailing these operations but it should be noted that the following units were involved:

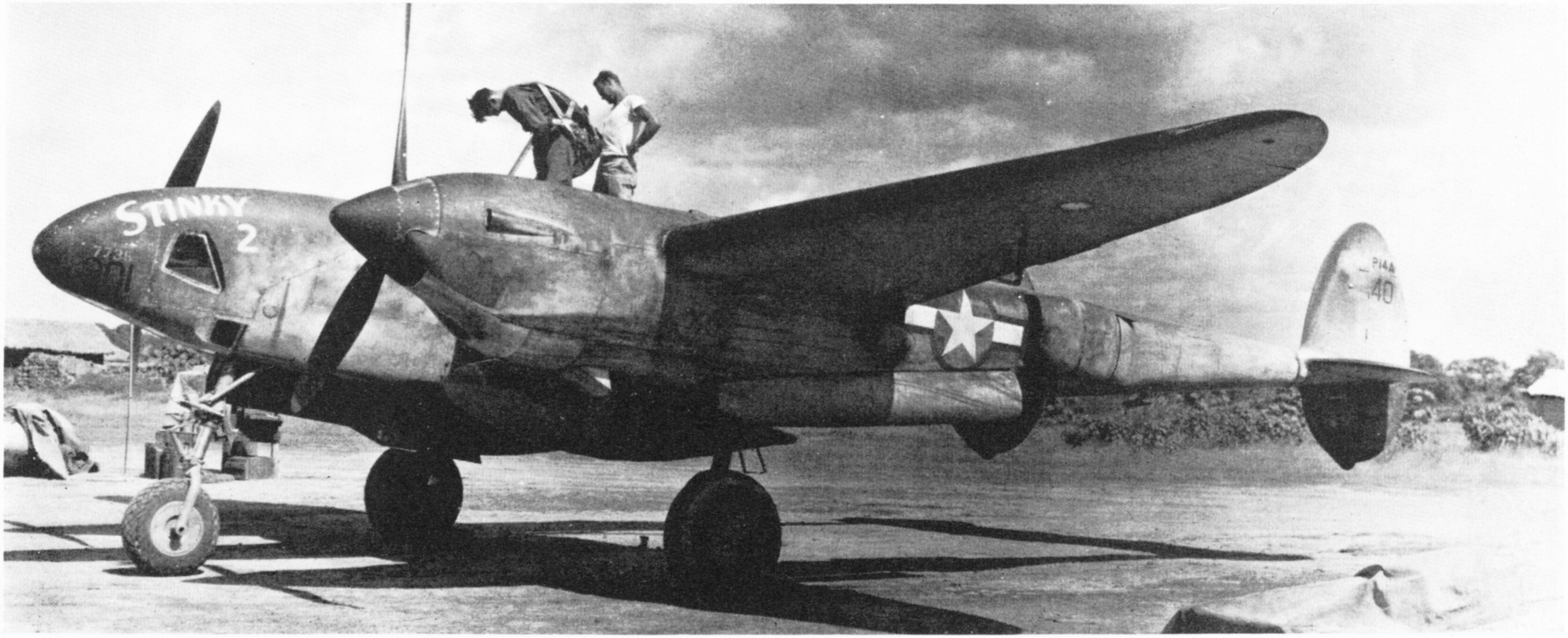
20th Fighter Group: Began operations in November 1943 and converted to P-51s in July 1944.

55th Fighter Group: Flew P-38s in combat from October 1943 to July 1944 when it converted to P-51s.

364th Fighter Group: Converting to P-51s in late July 1944 this Group had begun operations with P-38s in March 1944. Took part in first daylight raids over Berlin.

479th Fighter Group: The P-38 had even a shorter

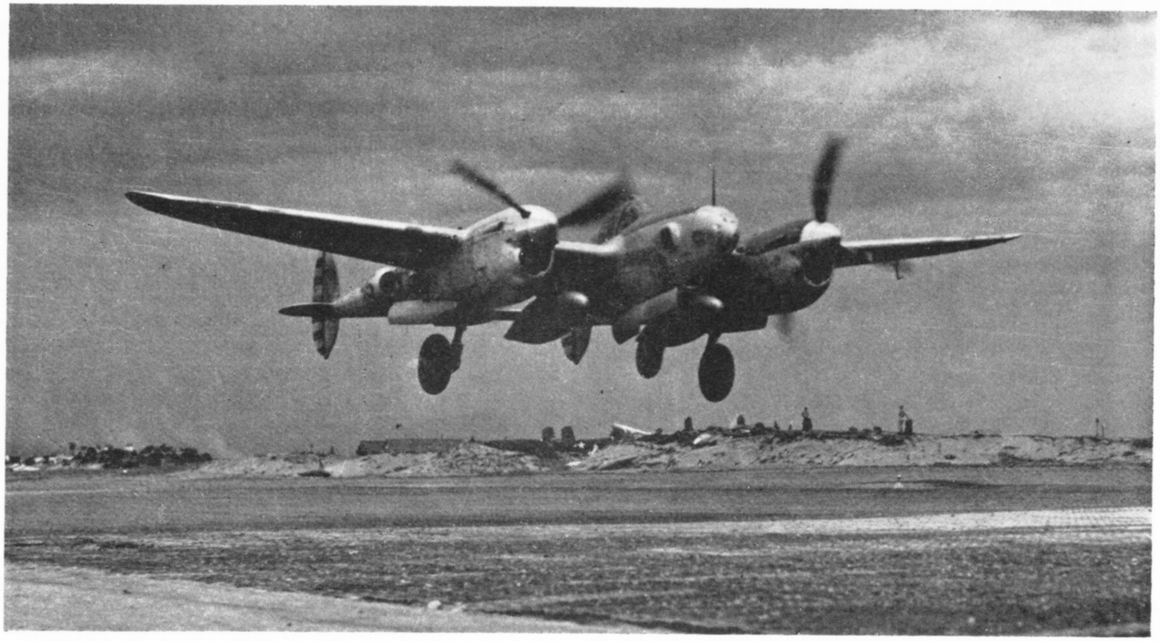
'Stinky' F-5A of the 9th Photographic Squadron, 7th Bombardment Group, at Pandaveswar, India. [*U.S.A.F., via Francillon.*



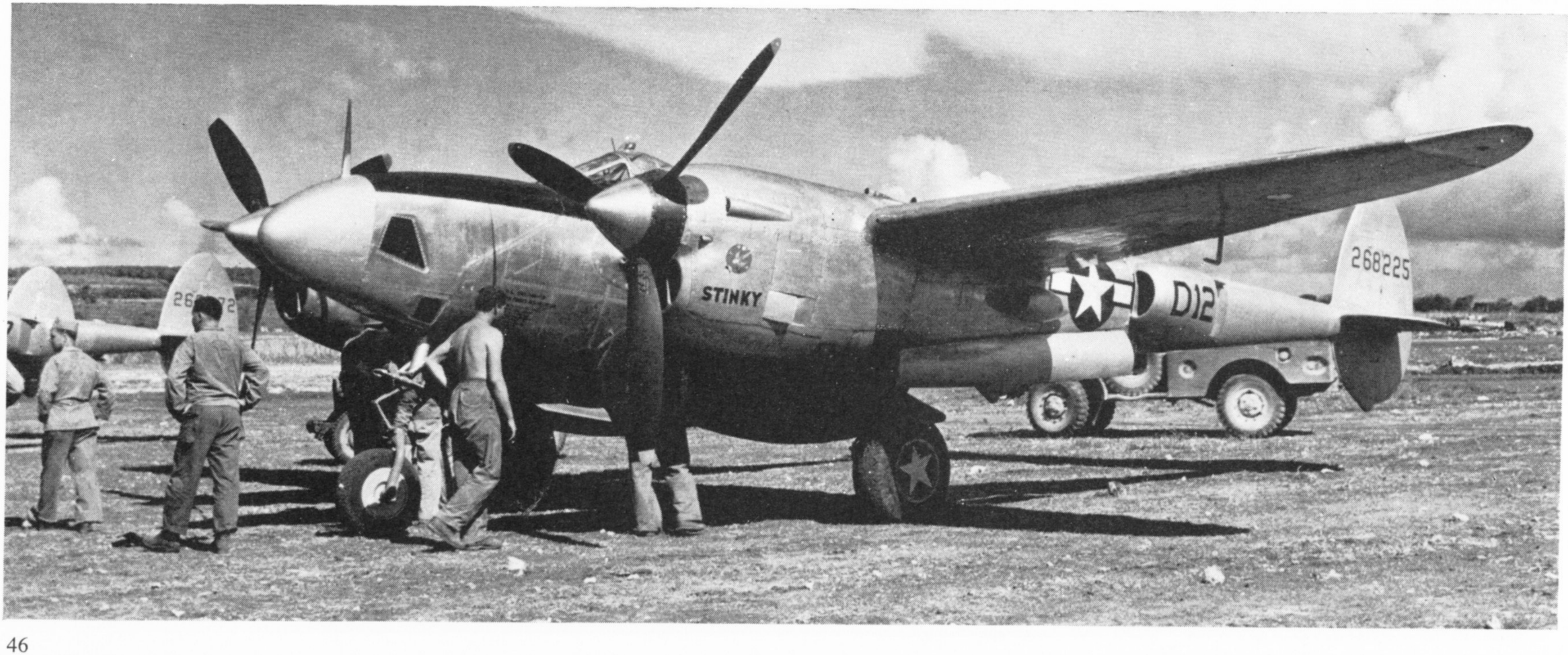
career with this Group as P-51s began to replace them in September 1944 only four months after the P-38s had first seen action.

As can be seen from this brief synopsis the P-38Js and Ls were not too successful with the Eighth Air Force despite their long-range and high-altitude performances in this theatre what at first appeared to be one of the strongest assets of the Lightning proved its demise, namely its twin-engined configuration. Although the P-38 could fly on one engine the Luftwaffe saw to it that such crippled aircraft would not return to base whilst two engines doubled the possibility of engine troubles. Consequently the staff and fighter pilots preferred the P-47s and, especially, the P-52s, and these they were able to receive in sufficient numbers to replace their P-38s. However, in the photo-reconnaissance role, the Lightning was more successful and the 7th Reconnaissance Group flew F-5s for the Eighth Air Force from November 1943 until V.E.-Day.

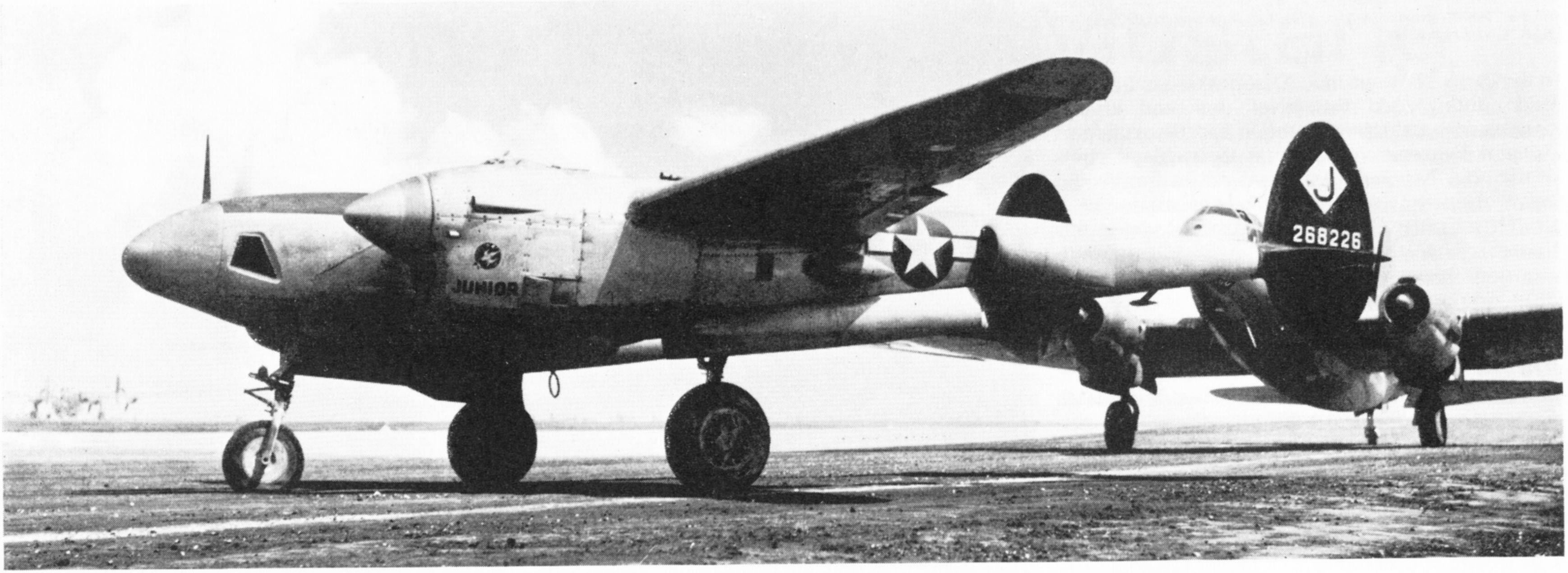
In the tactical role the Lightning was used in Northern Europe by six units of the Ninth Air Force: the 367th, 370th and 374th Fighter Groups and the 10th, 67th and 363rd Reconnaissance Groups. Only the



Belonging to the 28th Photographic Reconnaissance Squadron, this F-5B-1-LO 'Junior' was photographed at Wontan airstrip, Okinawa, in July 1945. [U.S.A.F., via Francillon.



F-5B-1-LO of the 4th Reconnaissance Group, 13th Air Force, at Isley Field, Saipan, July 10 1944. Note name and compare with photo on page 41. [U.S.A.F., via Francillon.

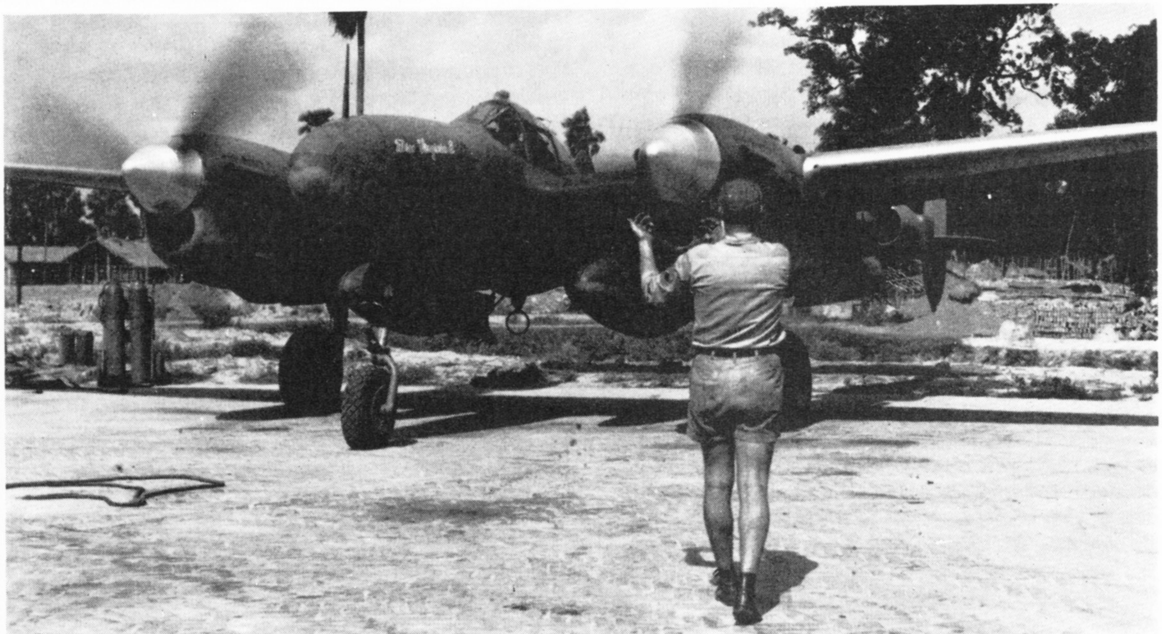


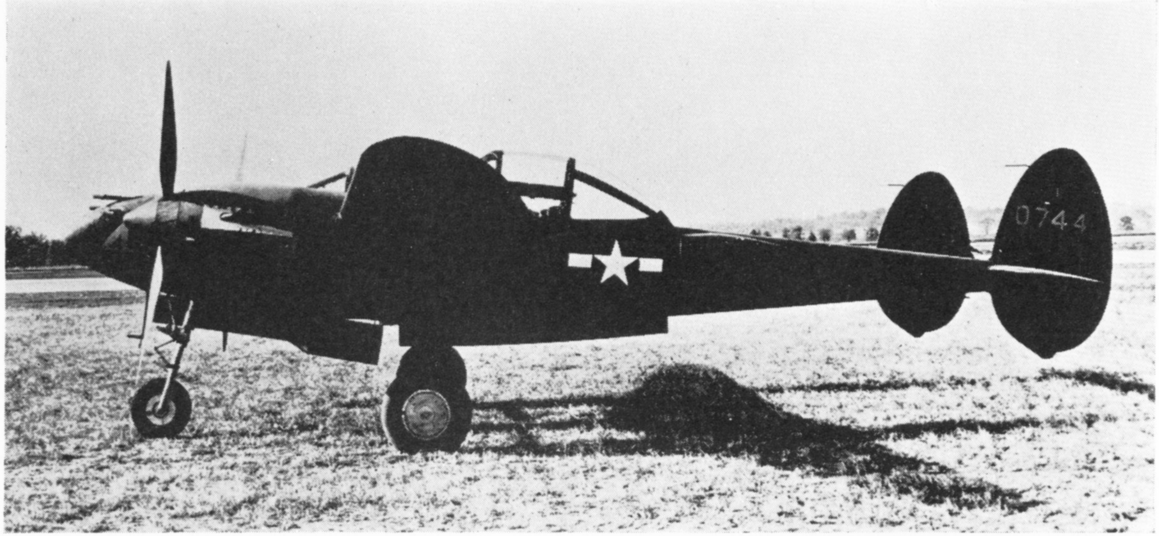
474th Fighter Group retained their P-38s until the end of the war, whilst the photo-reconnaissance role the F-5s were supplemented by the F-6s (Mustangs).

If in Northern Europe the P-38s did not endear themselves to the Eighth and Ninth Air Forces the Pacific was truly Lightning country. The first Lightning unit in this area was a flight of F-4s of the 8th Photographic Reconnaissance Squadron which, led by Major Karl Polifka, arrived at Port Moresby in April 1942. Their speed and high cruising altitude gave the F-4s almost complete freedom of interception and the legend of the Lightning began to be written by Major Polifka and his pilots. This Squadron was later attached to the 6th Reconnaissance Group which flew its F-5s in New Guinea, the Philippines and Okinawa. For use in the fighter role sixty P-38Fs arrived in Australia in late 1942 and, after modifications, were assigned to one squadron each of the 35th and 49th Fighter Groups. On December 27 twelve P-38Fs of the 39th Fighter Squadron, 35th Fighter Group, encountered 7 Vals and 20 Zekes over Cape Endaiadere, New Guinea, and claimed nine enemy fighters and two dive bombers for no loss. Four days later the P-38s had a similarly successful encounter with Zekes, and Major-General Ennis Whitehead, Deputy Commander of the Fifth Air Force, commented, 'we have the Japanese air force whipped'! Yet Lightnings were not to be available in sufficient numbers to our forces

An F-5G of the 6th Reconnaissance Group, heir of the first Lightning unit in the Pacific, at Lingayen Airstrip, Luzon, on May 17 1945. [*U.S.A.F., via Francillon.*

Below: F-5B-1-LO of the 9th Photographic Reconnaissance Squadron operating in India. 'Miss Virginia' is carrying two drop-tanks. [*U.S.A.F., via Francillon.*





First P-38 (40-744) modified as RP-38 with second cockpit on port boom to measure the effect of asymmetrical flight on pilot. [*via Francillon.*

in the Pacific for some time. Despite this handicap the P-38s distinguished themselves over and around Guadalcanal and the interception and destruction of Admiral Yamamoto's aircraft at the hands of pilots of the 12th, 70th and 339th Fighter Squadrons is but one of their many successes. Finally, in August 1943, the 475th Fighter Group became the first unit in this theatre to be solely equipped with P-38s. Other Lightning units operating in the south-west Pacific with the Fifth Air Force included the 8th and 347th Fighter Groups, whilst the Thirteenth Air Force in the South Pacific had the 18th Fighter Group, and the 4th Reconnaissance Group and the Seventh Air Force in the Central Pacific had only one P-38 unit, the 318th Fighter Group. Finally, to mention the other Lightning units which fought the Japanese, it must be noted that the type was flown in combat by the 343rd Fighter Group of the Eleventh Air Force in the Alaska/Aleutians area and by the 51st and 80th Fighter Groups and the 8th Reconnaissance Group in the CBI theatre of operations.

Space once again prevents us from listing the deeds of the P-38 in the Pacific but it must be remembered that the two top-ranking U.S. fighter aces, Major Richard I. Bong and Major Thomas B. McGuire, respectively, gained fame whilst flying P-38s with the 49th and 475th Fighter Groups.

The Lightning evaluated

The Lightning possessed neither the supreme handling characteristics of the Mustang nor the remarkable ability for surviving battle damage of the Thunderbolt, but its long range and high altitude performances turned it into an ideal weapon to fight the nimble Japanese aircraft over the vast expanse of waters in the Pacific. Cruising at high speed and high altitude, the P-38s were able to position themselves for fast diving attacks on Japanese formations and to zoom back to altitude, thus avoiding dogfights in which Japanese fighter aircraft had a marked advantage on account of their superior manœuvrability.

Over Europe, where the Luftwaffe aircraft had the altitude performances which their Japanese allies lacked, the P-38s were deprived of their main combat advantage. Yet their long range enabled them to participate in many spectacular missions such as the first daylight raids over Berlin. However, as the fuel capacity and range of the P-47s and P-51s were increased, the Lightnings all but disappeared from the inventory of the Eighth Air Force. In the tactical role their ability to carry a bomb-load equal to that of the B-17, whilst the ability of fighting their way back to base after dropping their external load was used to good advantage by units of the Ninth, Twelfth and Fifteenth Air Force. Furthermore, their heavy armament concentrated in the nose turned the P-38s into one of the most efficient strafing aircraft in the Allied inventory.

To paraphrase some of the most famous words of Sir Winston Churchill it can be said that if the twin-engined configuration of the P-38 was a blessing in disguise in combat, 'it seemed quite effectively disguised'. Two-thirds of each boom were occupied by the engine, turbo-supercharger, oil-cooler, radiator and related piping, thus offering a large target to enemy fire. Once one of the engines had been hit the Lightning could still fly but was offering a tempting target for enemy aircraft and, even if the pilot was lucky enough to avoid interception, he had to contend with a badly overheating engine. A Marine pilot who fought in the Solomons alongside a P-38 unit commented that during his tour of duty he remembered having seen only one P-38 returning successfully on one engine from the battle area. This pilot added that this situation badly affected the morale of the P-38 pilots to whom neither the idea of being captured by the Japanese nor the idea of drifting in shark-infested waters had much appeal.

Specification	XP-38	P-38D	P-38F	P-38H	P-38J
Span, ft. in.	52 0	52 0	52 0	52 0	52 0
Length, ft. in.	37 10	37 10	37 10	37 10	37 10
Height, ft. in.	12 10	9 10	9 10	9 10	9 10
Wing area, sq. ft.	327.5	327.5	327.5	327.5	327.5
Empty weight, lb.	11,507	11,780	12,264	12,380	12,780
Loaded weight, lb.	13,500	14,456	15,900	16,300	17,500
Maximum weight, lb.	15,416	15,500	18,000	20,300	21,600
Wing loading, lb./sq. ft.	41.2	44.0	48.5	49.8	53.4
Power loading, lb./h.p.	5.9	6.3	6.0	5.7	6.1
Maximum speed, m.p.h./ft.	413/20,000	390/20,000	395/25,000	402/25,000	414/25,000
Cruise speed, m.p.h./ft.	—	300	305	300	290
Climb rate, ft./min.	20,000/6.5	20,000/8	20,000/8.8	20,000/8.5	22,000/7
Service ceiling, ft.	38,000	39,000	39,000	39,000	44,000
Normal range, miles	—	400	425	350	450
Maximum range, miles	—	975	1,925	2,400	2,600
Power plant	V-1710-11 & -15	V-1710-27 & -29	V-1710-49 & -53	V-1710-89 & -91	V-1710-89 & -91
T.O. rating, h.p.	1,150	1,150	1,325	1,425	1,425
Maximum rating, h.p./ft.	1,000/20,000	—	1,150/25,000	1,240/27,000	1,425/27,000
Armament	None fitted	1 × 37 mm. 4 × 0.50 in.	1 × 20 mm. 4 × 0.50 in. 2,000-lb. bomb	1 × 20 mm. 4 × 0.50 in. 4,000-lb. bomb	1 × 20 mm. 4 × 0.50 in. 4,000-lb. bomb

North American P-51 Mustang

At 1429 hours on December 1 1943, twenty-four P-51B Mustangs led by Col K. R. Martin took off from Boxted, Essex. One hour and twenty minutes later they landed back at base after an uneventful sweep over north-eastern France. Yet this inconspicuous mission was as significant from the historical point of view as it was insignificant from the purely tactical point of view. It was the first operational sorties of the first fighter unit—the 354th Fighter Group—of the newly constituted Ninth Air Force in England, but, more significantly, it was the first operation by Merlin-powered Mustangs, the best all-around fighter of the Army Air Forces. Even though V.J.-Day came only twenty and one half months after this mission this aircraft became as famous as the British Spitfires and German Bf 109s which operated throughout the war. But perhaps the most amazing part in the history of this, the most famous American fighter aircraft, is that it was not developed in answer to an American requirement and that it initially failed to win an Army Air Corps production contract.

Design history

In the early spring of 1940 the British Purchasing Commission were feverishly evaluating existing and projected types of fighter aircraft available for sale in the then neutral United States. Of all types the Lockheed P-38 was the most promising machine but some time was to go by before it would be available in sufficient numbers. Next on their list was the Curtiss Hawk 87A-1—equivalent to the P-40D of the Army Air Corps—but the British Purchasing Commission feared that Curtiss would not be able to manufacture enough aircraft to meet both American and British contracts. The obvious solution was to find a second manufacturer willing to produce the Hawk 87A-1 under licence. As, at the time, the members of the British Purchasing Commission had established a close working relationship with the management and staff of North American Aviation Inc., which had been producing Harvard advanced trainers for the R.A.F. for a period, they approached this company with the idea of participating in the Hawk 87A-1 production programme. To their surprise North American flatly rejected the idea, but offered to build a new fighter which the company had been studying with the idea of incorporating in its design the features which early combat experience in Europe had revealed necessary. As the calculated characteristics and performances of the proposed fighter were markedly superior to those of the Hawk 87A-1, powered by the same Allison V-1710-39, the British Purchasing Commission were willing to sign a contract if North American were willing to guarantee delivery of the prototype in no more than 120 days. On May 4 1940 the contract was signed.

Designed under the supervision of Dutch Kindelberger by a team led by Raymond Rice and Edgar Schmued, the NA-73X prototype was completed in 117 days, but first flight was delayed until October 26 1940 by the late delivery of its V-1710-39 liquid-cooled engine. The aircraft was characterised by its beautifully streamlined fuselage with low-drag radiator mounted under the fuselage aft of the pilot, and by its laminar-flow wing. Proposed armament, not installed on the prototype, included two 0.50 in. machine-guns under the engine and one 0.50-in. and two 0.30-in. machine-guns in each wing. During its trials the NA-73X demonstrated extremely pleasant handling characteristics and at 13,000 ft. it was 25 m.p.h. faster than the Hawk 87A-1, which North American had refused to build.

When the U.S. Government had authorised North American to design and build their Na-73 fighter for the British they had requested that two aircraft from the initial production batch be delivered to the Army Air Corps, this transaction being covered by a contract signed on September 20 1940. Accordingly, the fifth and tenth Mustangs Is, as production aircraft were known to the British, were delivered as XP-51s to the Army Air Forces (41-38 and 41-39) at Wright Field, Ohio, for evaluation. Despite the favourable reports on the XP-51 filled by service test pilots, the Army Air Forces did not, at the time, order the aircraft into production as, allegedly, the P-47 and P-38 were supposed to meet all their needs.

The story of the Mustang in service with the Army Air Forces may well have ended there if it were not for two developments which took place in the United Kingdom. The first of these events was the R.A.F. decision, on account of the aircraft's limited performances at high altitudes, to assign the Allison-powered Mustangs to Army Co-operation Command and to install cameras in their fuselage. Indirectly this decision led to the development in the United States of the A-36 dive-bomber and F-6 reconnaissancd aircraft. The second of these developments, which was to have by far a stronger impact on the Mustang's future, was

One hundred and fifty P-51s were built, but the majority went to the R.A.F. or were converted as F-6As. [*North American, via Francillon.*

the experimental installation in four Mustang I airframes (AL963, AL975, AM203 and AM208) of Rolls-Royce Merlin 61 or 65 engines driving four-blade propellers. So successful were these modified aircraft that Major Thomas Hitchcock, a U.S. military attaché in England, prevailed upon the Army Air Corps to order from North American two prototypes (XP-78), powered by Packard-built Merlin engines.

Meanwhile the gravity of the situation following America's entry into the war led to the acquisition by the Army Air Forces of a number of Allison-powered Mustangs (P51s and P-51As) which had been ordered for the British under Defence Aid contracts, whilst the need for high-performance single-engined light attack aircraft led the Army Air Forces to order, in August 1942, a specialised version of the Mustang, the A-36A. At last the Mustang was in production for the Army Air Forces.

Mustang development

XP-51: Two aircraft (41-38 and 41-39) from first British production contract delivered to the Army Air Corps. Allison V-1710-39 engine. Two 0.50-in. machine-guns in fuselage and two 0.50-in. and four 0.30-in. machine-guns in wings.

P-51: Ordered under Defence Aid contracts for the R.A.F. and assigned both U.S. serials (41-37320 to 41-34469) and British serials (FD418 to FD567). V-1710-39 engine and armament consisting of four wing-mounted 20-mm. cannons. Of these 150 aircraft, 93 were delivered to the R.A.F., two became the XP-51B prototypes and 55 were kept by the Army Air Forces and modified as F-6A reconnaissance fighters.

P-51A-1-NA of the First Air Commando Group, India, 1944. See drawing on page 50 for colour details. [U.S.A.F.; via Francillon.

P-51A: Lend–Lease contracts for 310 aircraft (43-6003 to 43-6312), of which 50 went to the R.A.F. as Mustang IIs and 35 became F-6B reconnaissance fighters. More powerful V-1710-81 engine and armament reduced to four wing-mounted 0.50-in. machine-guns. Underwing racks for 1,000 lb. of bombs and/or bazooka-type rocket launchers. One aircraft acquired by U.S. Navy (BuNo. 57987) and used for carrier trials.

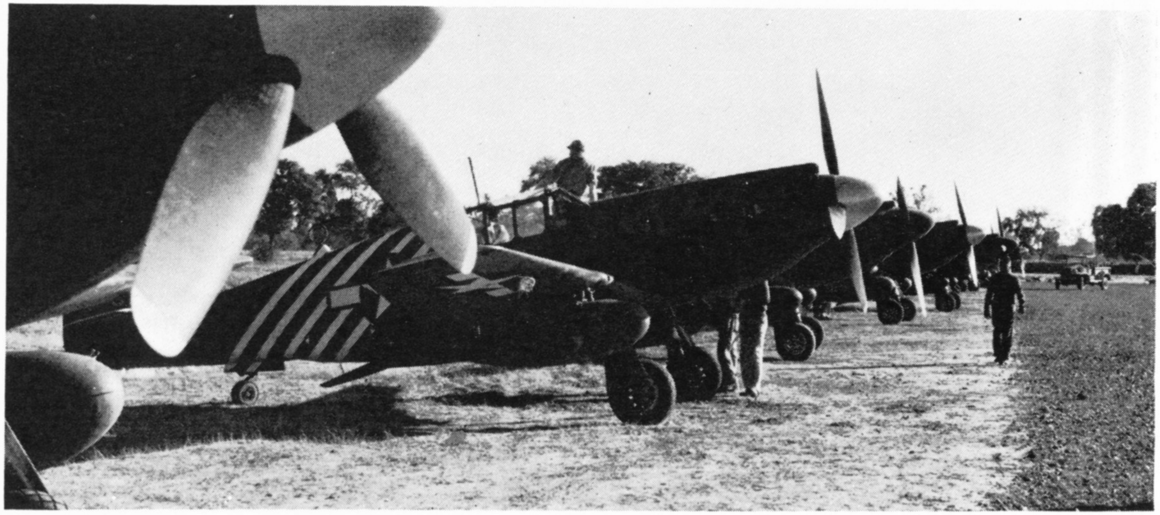
XP-51B: American prototypes of the Merlin-powered Mustang originally designated XP-78s and tentatively named Apache. Packard V-1650-3 engine installed on two P-51 airframes (41-37352 and 41-37421) and driving a four-blade propeller. Wing-mounted cannons retained. Flight trials began in September 1942 and the XP-51B reached a maximum speed of 441 m.p.h. at 29,800 ft. and time to 20,000 ft. was reduced by 35 per cent as compared to the P-51A.

P-51B: First production version of the Merlin-powered Mustang, of which 1,988 were built (42-106429 to 42-106538, 42-106541 to 42-106978, 43-6313 to 43-7202, 43-12093 to 43-12492 and 43-24752 to 43-24901) in the Inglewood plant of North American. V-1650-3 engine rated at 1,380 h.p. on take-off and 1,595 h.p. at 17,000 ft., fitted on P-51B-1-NA to P-10-NA and V-1650-7 rated a 1,420 h.p. on take-off and 1,720 h.p. at 17,000 ft. on later blocks. Same armament installations as on the P-51A with wing racks for bombs or drop-tanks. Seventy-one of these aircraft were modified as F-6C and 275 were delivered to the R.A.F. A successful field modification was the fitting of a Malcolm hood, offering improved visibility and more pilot's head-room. At least one aircraft was modified as two-seat trainer/communication aircraft by removing the radio equipment and mounting a second seat under a Malcolm hood behind the pilot's seat.

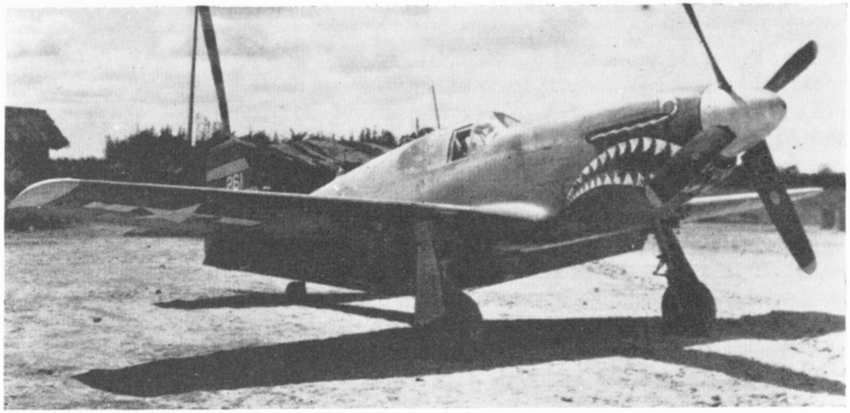
P-51C: Basically identical to the P-51Bs, 1,750 P-51Cs were built in North American's Dallas plant. The V-1650-3 was fitted only to the P-51C-1-NT, whilst all other blocks had the V-1650-7. Serials: 42-106979 to 42-103978, 43-24902 to 43-25251 and 44-10753 to 44-11152 included 636 aircraft delivered to the R.A.F. as Mustang IIIs and 20 aircraft modified as F-6Cs. Some aircraft were fitted in the field with Malcolm hood and a dorsal fin.

P-51D: Accounting for over half the Mustang's production, the P-51D was characterised by a cut-down aft fuselage and a new canopy offering all-round vision. Two experimental aircraft, 42-106539 and 42-106540, were obtained by modifying two airframes built in a P-51B-10NA batch. Armament was increased to six wing-mounted 0.50-in. machine-guns. Following the two experimental aircraft no less than 6,500 P-51D-NAs were delivered by the Inglewood plant (44-13253 to 44-15752, 44-63160 to 44-64159 and 44-72027 to 44-75026), whilst the Dallas plant built 1,600 P-51D-NTs (44-11153 to 44-11352, 44-12853 to 44-13252, 44-84989 and 45-11343 to 45-11742). However, 136

Line-up of P-51As of the First Air Commando Group shortly before this unit began operations in support of Wingate's raiders. [U.S.A.F., via Francillon.



P-51Bs of the 23rd Fighter Group shortly after this Group received their Mustangs in August 1944. [*U.S.A.F., via Francillon.*



P-51B of the 23rd Fighter Group, Fourteenth Air Force, China, November 1944. [*U.S.A.F., via Francillon.*

P-51D-NTs were actually completed on the assembly lines as F-6Ds and ten as TP-51D-NTs. Powered by V-1650-7 engines the P-51Ds underwent a series of modifications during their production life. These modifications, amongst others, included the addition of a dorsal fin and the installation of zero-length rocket launchers beneath the wings, whilst maximum bomb-load was doubled to 2,000 lb. Despite the larger numbers of P-51Ds built only comparatively few, 285 to be precise, were delivered during the war to the R.A.F., and one (44-14017) underwent carrier trials aboard the U.S.S. *Shangri-La* (CV-38) in 1944.

TP-51D-NT: Ten P-51D-NT (44-84610, 44-846111 and 45-11443 to 45-11450) fitted with dual controls. Both pilots sat under the normal bubble canopy.

TF-51D: Post-war modification by Temco of a number of P-51Ds. Large fin and elongated canopy. (Note that in 1948 all Mustangs in the inventory became F-51s.)

P-51E: Designation not assigned.

XP-51F: Three experimental lightweight aircraft (43-43332 to 43-43334) built at Inglewood. Armament reduced to four 0.50-in. machine-guns and V-1650-7 engine driving a three-blade propeller. One delivered to the R.A.F. Used smaller wheels which enabled to use a straight wing leading edge and featured a low-drag canopy, modified cooling system and fuel system. First flown on February 14 1944.

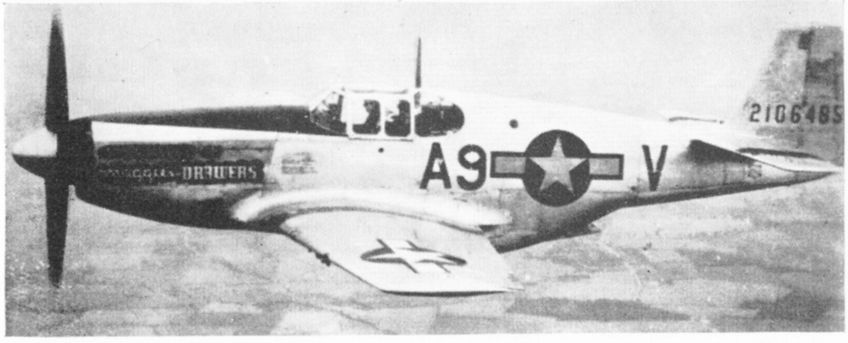
XP-51G: Two additional lightweight prototypes powered by a Rolls-Royce Merlin 145M driving a five-blade propeller (43-43335 and 43-43336). One went to England. Armament: six wing-mounted 0.50-in. machine-guns. First flown on August 9 1944.

P-51H: Specially intended for use in the Pacific, the P-51H used the modified wings of the XP-51F. Internal modifications, specially in the engine installation, resulted in an empty weight reduction of 540 lb. compared to the P-51D. V-1650-9 driving a four-blade propeller and six wing-mounted 0.50-in. machine-guns. Originally tested with vertical tail surfaces similar to those of the P-51D, the aircraft was fitted with taller surfaces as the smaller canopy affected airflow. A total of 555 P-51Hs were built at Inglewood (44-64160 to 44-64714) and many more were cancelled after V.J.-Day. One went to the R.A.F. and one (44-64192) was handed over to the U.S. Navy in August 1948 (BuNo. 109064). First flew on February 3 1945.

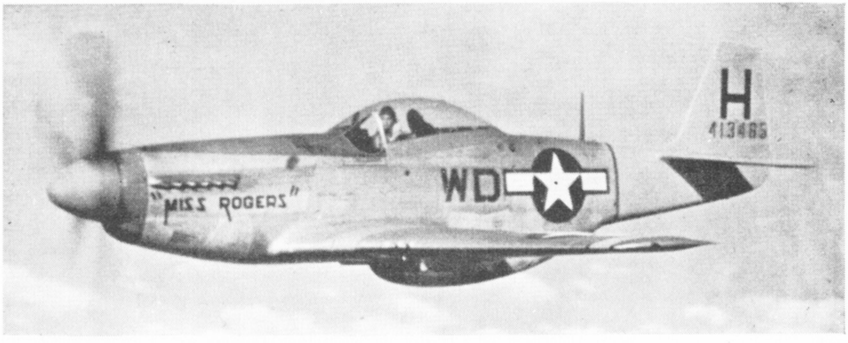
XP-51J: Fastest Mustang version of which two (43-76027 and 34-76028) were built in Inglewood. Lightweight aircraft similar to the XP-51F but powered by an Allison V-1710-119 enclosed in a low-drag cooling. First flown on April 23 1945, the aircraft had a top speed of 491 m.p.h. at 27,400 ft.

P-51K: Similar to the P-51D-NT except for the replacement of the Hamilton Standard propeller by an Aeroproducts unit. Of 1,500 P-51Ks built at

P-51B-10-NA of the 380th Fighter Squadron, 363rd Fighter Group, Ninth Air Force. [*U.S.A.F., via Francillon.*



P-51D of 335th Fighter Squadron, 4th Fighter Group, 65th Fighter Wing, 8th Air Force. Note location of individual aircraft letter on tail. [*via Francillon.*



Dallas (44-11353 to 44-12852), 593 went to the R.A.F. and 163 were modified as F-6Ks.

P-51L: Projected version of the P-51H to be built at Dallas and to be powered by a V-1650-II engine. Contract cancelled.

P-51M: Dallas-built version of the P-51H of which one only (45-11743) was built before contract cancellation.

A-36A: First Mustang version to be ordered by the Army Air Forces for their own use. This was a V-1710-87-powered dive-bomber aircraft fitted with dive brakes beneath the wings. Armament consisted in two 0.50-in. machine-guns beneath the engine, four wing-mounted 0.50-in. machine-guns and two 500-lb. bombs. Five hundred built (42-83663 to 43-84162), of which one went to the R.A.F.

F-6A: Reconnaissance fighter aircraft obtained by fitting K-24 cameras in the fuselage of 55 P-51s.

F-6B: Similar modification of 35 P-51As.

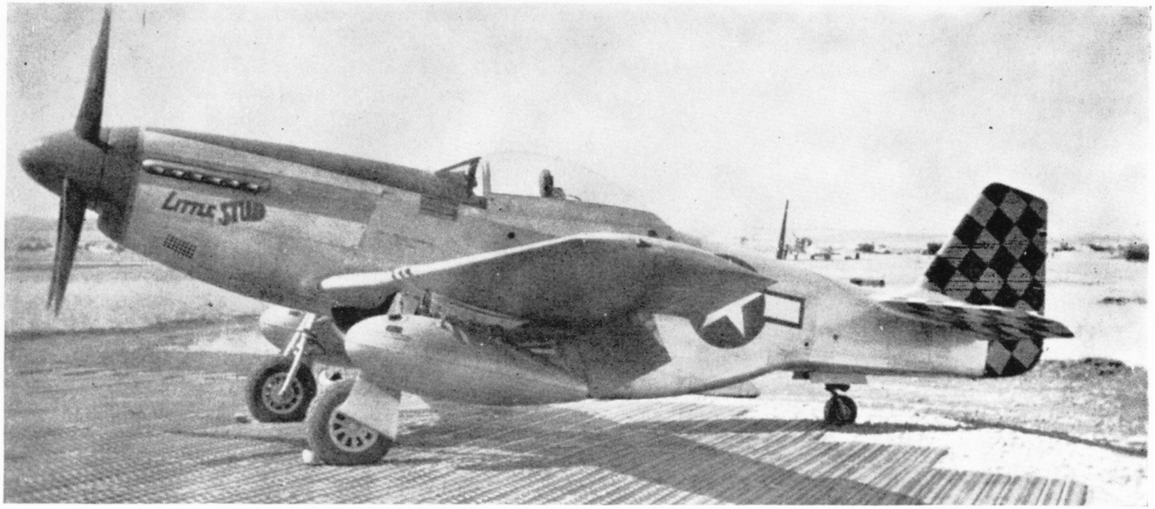
F-6C: Reconnaissance fighter aircraft with two K17, K-22 or K-24 cameras in the rear fuselage. Seventy-one P-51Bs and twenty P-51Cs so modified.

F-6D: Similar modification of 136 P-51D-NTs.

F-6K: Similar modification of 163 P-51Ks.

Note: All F-6 reconnaissance fighter versions of the Mustang retained the armament and serial numbers of the fighter aircraft from which they were converted.

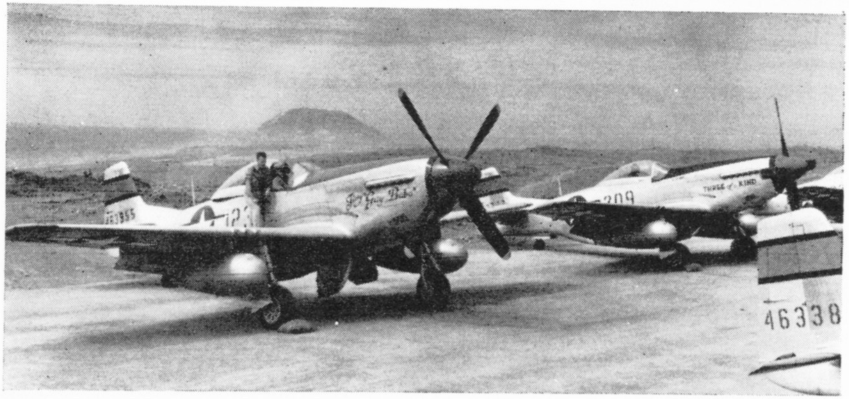
When production ended a total of 15,686 Mustangs has been built. This total included one NA-73X prototype, 620 Mustangs ordered under British contracts, 80 P-51Ds built by North American but assembled in Australia by Commonwealth Aircraft Corporation Pty., 120 P-51Ds built by Commonwealth Aircraft Corporation Pty., 500 A-36As and 14,365 aircraft ordered by the United States under the P-51 designations (480 of which were delivered as F-6s).



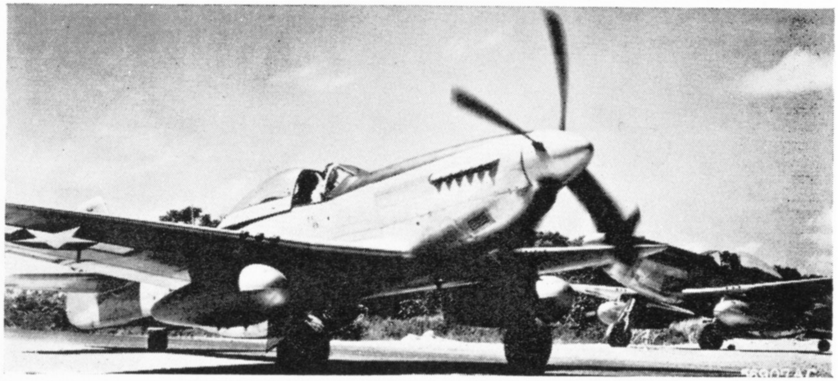
P-51D 'Little Stud', in which Col Robert Baseler, C.O. of the 325th Fighter Group, 15th Air Force, flew on an unauthorised solo sweep over the Balkans. [*R. Baseler, via Francillon.*

Service history

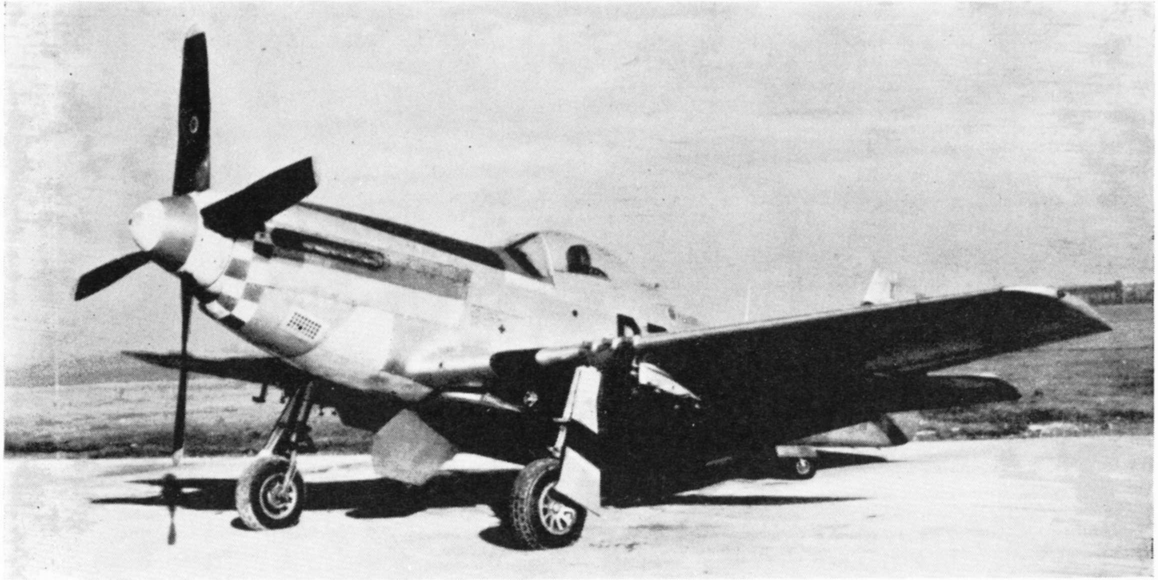
Whilst the honour of first taking the Mustang into combat fell to No. 2 Squadron of the Royal Air Force the Army Air Force gained their first combat experience with the Mustang when the 111th Tactical Reconnaissance Squadron of the 68th Reconnaissance Group began to operate some F-6As in North Africa during the winter of 1942–3. Soon this Group, which was attached to the Twelfth Air Force, added another squadron of F-6As, whilst during the following summer the 27th and 86th Bombardment Groups (Dive)—later designated Fighter-Bomber Groups—took the A-36As into combat. During operation in Italy the A-36As gave satisfaction but their dive brakes had to be wired shut, as they badly affected lateral control when they were extended. Performance at low altitudes was satisfactory but the offensive load (2 × 500 lb. bombs) was wholly insufficient, as by that time most conventional fighter aircraft could carry a similar or larger load. Consequently both groups converted in 1944 first to P-40s and then to P-47s. The only other operational group to fly A-36As was the 311th Fighter-Bomber Group of the Tenth Air Force, which began operations in India in September 1943 but converted to Merlin-powered Mustangs within a year.



P-51Ds of 72nd Fighter Squadron, 21st Fighter Group, Iwo Jima. [*U.S.A.F., via Francillon.*



Mustangs of the 20th Air Force were the first A.A.F. fighters to fly over Japan. [*U.S.A.F., via Francillon.*



P-51D of 503rd Fighter Squadron, 339th Fighter Group, 66th Fighter Wing, 8th Air Force. [*Francillon.*

Other Allison-powered Mustangs were flown by the 107th Tactical Reconnaissance Squadron, 67th Reconnaissance Group, which flew F-6Bs from England, and the 1st Air Commando Group which used P-51As for providing air cover to Wingate's Raiders operating behind enemy lines in Burma.

As already noted the turning point in the Mustang's career with the Army Air Forces was the December 1 1943 mission by P-51Bs of the 354th Fighter Group. Significantly, Lt-Col Blakeslee, Executive Officer of the famous 4th Fighter Group of the Eighth Air Force, had flown one of the Mustangs of the 354th during their first operational mission. That single sortie was all it took to convince Lt-Col Blakeslee that this was the fighter aircraft the Eighth Air Force had been waiting for. With it the bombers could be escorted all the way to and from their targets, and the P-51 had the performance and manœuvrability to combat successfully the best German fighter aircraft. An informal agreement was reached between the Eighth and the Ninth Air Forces that the Eighth would receive priority on Mustang deliveries whilst the Ninth would use the P-47s (with its sturdy airframe, effective bomb-load and powerful punch) as their primary tactical fighter aircraft. Accordingly only two other Fighter Groups of the Ninth Air Force, the 363rd and 370th, flew P-51s, whilst three Reconnaissance Groups, the 10th, 67th and 363rd, received F-6Cs, F-6Ds and F-6Ks. Before leaving the Ninth Air Force it must be noted that Major James Howard, 356th Fighter Squadron, 354th Fighter Group, earned the Congressional Medal of Honor—his country's highest award—for a sortie in his P-51B-5NA (43-6374, code AJ-A 'Ding-Hao') on June 11 1944. Despite the failure of first two, then three and finally all four of his guns, Major Howard single-handedly protected a formation of Flying Fortresses and was credited with the destruction of four enemy aircraft. Major Howard's experience with gun failures was unfortunately not an uncommon occurrence, and the P-51B suffered from such failures until the cartridge chutes were modified.

In March 1944 the 4th Fighter Group became the first unit of the Eighth Air Force to re-equip with Mustangs. Within nine months all fifteen Fighter Groups of the Eighth Air Force—with the notable exception of the 56th Fighter Group—had exchanged their P-38s and P-47s for P-51s. Another Eighth Air Forces unit to fly Mustangs was the 7th Photographic Group, which had their own P-51Ds to provide escort to their F-5 Lightnings. In just over thirteen months of operations the Mustangs of the Eighth Air Force piled up success upon success, and together with the P-51s of the Ninth Air Force accounted for 9,081 enemy aircraft destroyed (4,950 of which in air-to-air combat), or a fantastic 48.9 per cent of all enemy aircraft destroyed by A.A.F. fighters in the E.T.O. between 1942 to 1945. During this period the Merlin-powered Mustangs participated in a number of spectacular operations, such as the three-way shuttle missions between England, Russia and Italy, and pilots such as Captain Don S. Gentile, Lt-Col John C. Meyer and Lt-Col John D. Landers won fame whilst flying with the Eighth Air Forces.

Although the Merlin-powered P-51s are best remembered for their operations in Northern Europe, they were equally successful in escort operations with units of the Fifteenth Air Force in Italy. In the C.B.I. theatre of operations their appearance helped counter the menace of the FRANK, the remarkable Nakajima Fighter introduced in China by the Japanese in August 1944. Amongst these C.B.I.-based units the 23rd Fighter Group, the heir of the American Volunteer Group, must be singled out, and their aircraft carried the notorious Tiger Mouth motif.

With the exception of the deeds of the Iwo Jima-based Mustangs of the 15th, 21st and 406th Fighter Groups which escorted the B-29s over Japan (on April 7 1945 the P-51Ds of the 15th and 21st Fighter Groups became the first Army Air Forces' fighters to fly over Japan), little is now remembered of the limited operations by Mustangs in the Pacific. Yet at least one mission deserves a special place in history. On January 11 1945 Captain William S. Shome and his wingman, 2nd Lt Paul M. Lipscomb of the 82nd Tactical Reconnaissance Squadron, 71st Reconnaissance Group, were flying their F-6Ks over Northern Luzon when they met a single Japanese bomber escorted by twelve fighters. This was the first combat experience for both pilots, but neither hesitated, and minutes later Captain Shomo had destroyed the Jap bomber and six of its escorting fighters, whilst 2nd Lt Lipscomb destroyed four fighters. For his seven-planes-in-a-single-action record Captain Shomo was awarded the Congressional Medal of Honor.

After the war the Mustang—primarily in its P-51D, P-51H, P-51K, F-6D and F-6K versions—remained in service with the Army Air Force and a large number of these aircraft were taken over by the U.S.A.F. upon the formation of that Service. However, with the introduction of an increasing number of jet fighters the F-51s and RF-51s were transferred to Air National Guard units. The communist invasion of South Korea on June 25 1950 brought the Mustangs back into combat, and the F-51s of the 8th, 18th and 35th Fighter Wings were amongst the most active Allied aircraft in the early part of this war. The threat of the MIG-15s finally resulted in the retirement of one of the greatest piston-powered aircraft extant.

A number of Mustangs were sold as surplus to civilian operators, beginning immediately after the end of the war, and several are still being listed on the

P-51D-25-NAs of 458th Fighter Squadron, 506th Fighter Group, on Iwo Jima. [*U.S.A.F., via Francillon.*

U.S. Civil Register, being used as executive aircraft and racers. Oddly enough some of these ex-surplus aircraft, overhauled and modified as counter-insurgency aircraft by Cavalier Aircraft Corporation are being re-purchased by the U.S. Government for delivery to South American countries through the United States Military Assistance Program. Two additional aircraft in two-seat configuration have been delivered to the U.S. Army for use in pace-chase missions in connection with the flight trials of the Lockheed AH-56 Cheyenne.

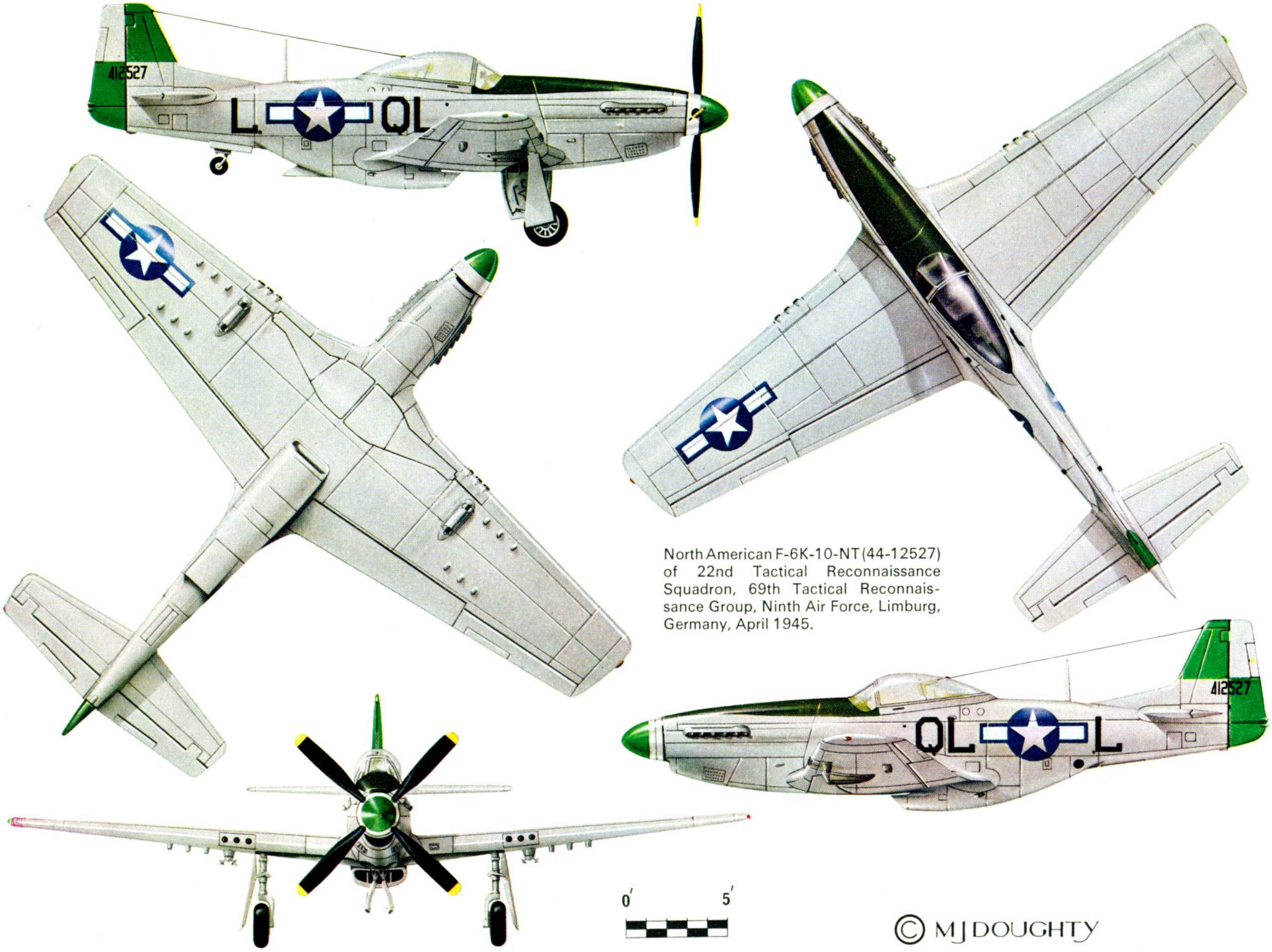
Finally, and to prove that old soldiers never die, Cavalier Aircraft Corporation are presently actively marketing the 'Mustang 3', designed to perform low-level, close air support mission. Once again Rolls-Royce supply the power plant but their Merlin has given place to the Dart turboprop, the Mk. 510 on the prototype converted from an existing airframe and the Mk. 529 on the proposed all-new production version.

The Mustang evaluated

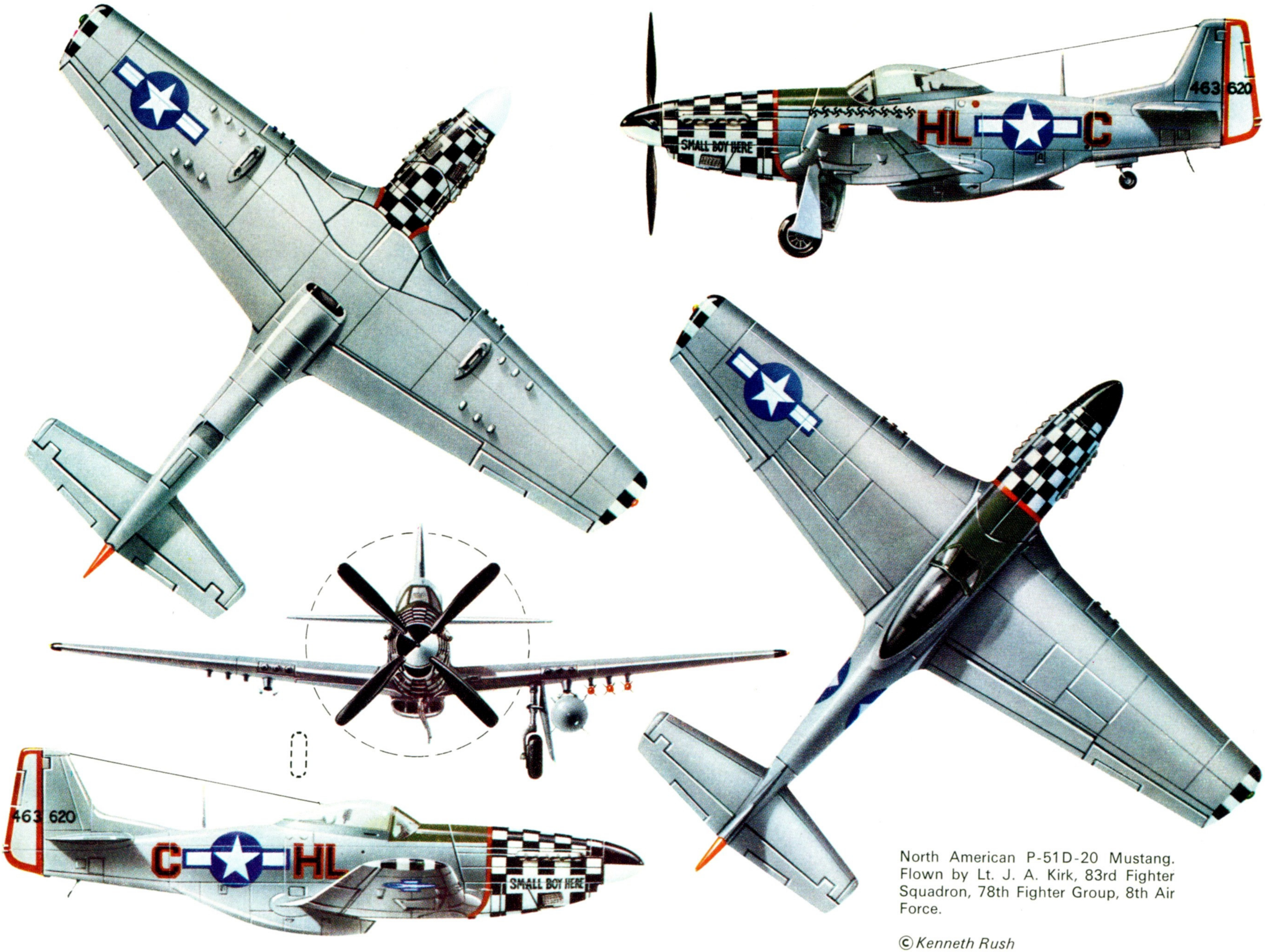
The outstanding operational record of the Mustang during the last two years of the Second World War speaks for itself. The P-51, once re-engined with the superb Rolle-Royce (Packard-built) Merlin, was truly a spectacular fighter, and its performances and handling characteristics endeared it to all pilots who took it into combat.

The qualities of the Mustang being still vividly remembered little remains to be said in its praise that has not yet been said time and again. Indeed, very little can be found to fault this formidable fighting machine. Yet the P-51 was not faultless. Its cockpit was, considering the size of the average American fighter pilot, somewhat cramped, thus resulting in considerable pilot's fatigue during the long escort sorties at which this aircraft excelled. However, this condition was substantially improved with the introduction of the P-51D. Another deficiency of the Mustang, one which had more serious consequences,

P-51H 'Ah'm Available' of the 62nd Fighter Squadron in flight over the Crazy Mountains, Alaska. Note twin radio aerials. [*U.S.A.F., via Francillon.*

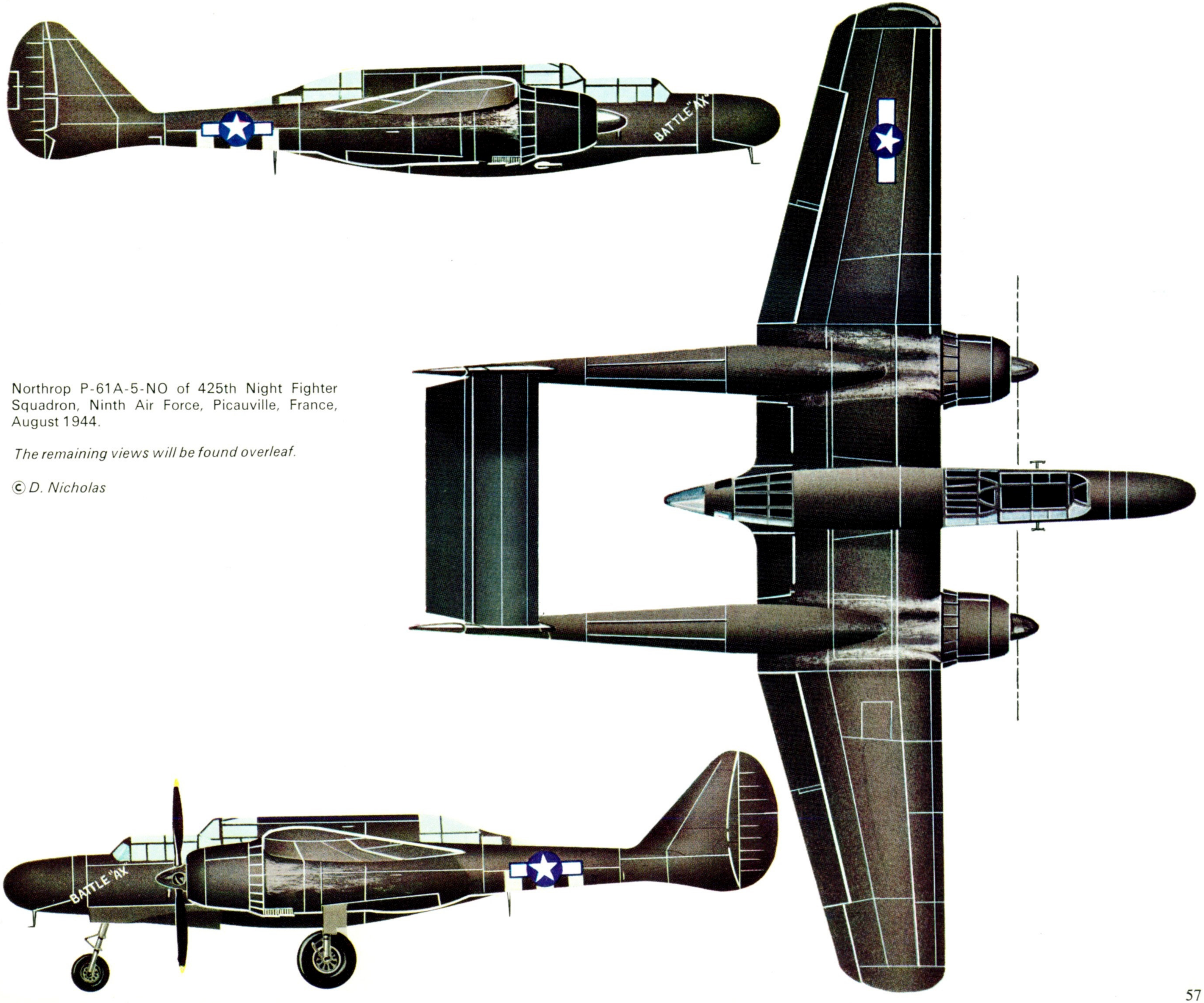

412527
L
QL
QL
L
412527
0′
5′
© MJ DOUGHTY

North American F-6K-10-NT (44-12527) of 22nd Tactical Reconnaissance Squadron, 69th Tactical Reconnaissance Group, Ninth Air Force, Limburg, Germany, April 1945.


463 620
HL
C
SMALL BOY HERE
C
HL
463 620
SMALL BOY HERE

North American P-51D-20 Mustang. Flown by Lt. J. A. Kirk, 83rd Fighter Squadron, 78th Fighter Group, 8th Air Force.

© Kenneth Rush

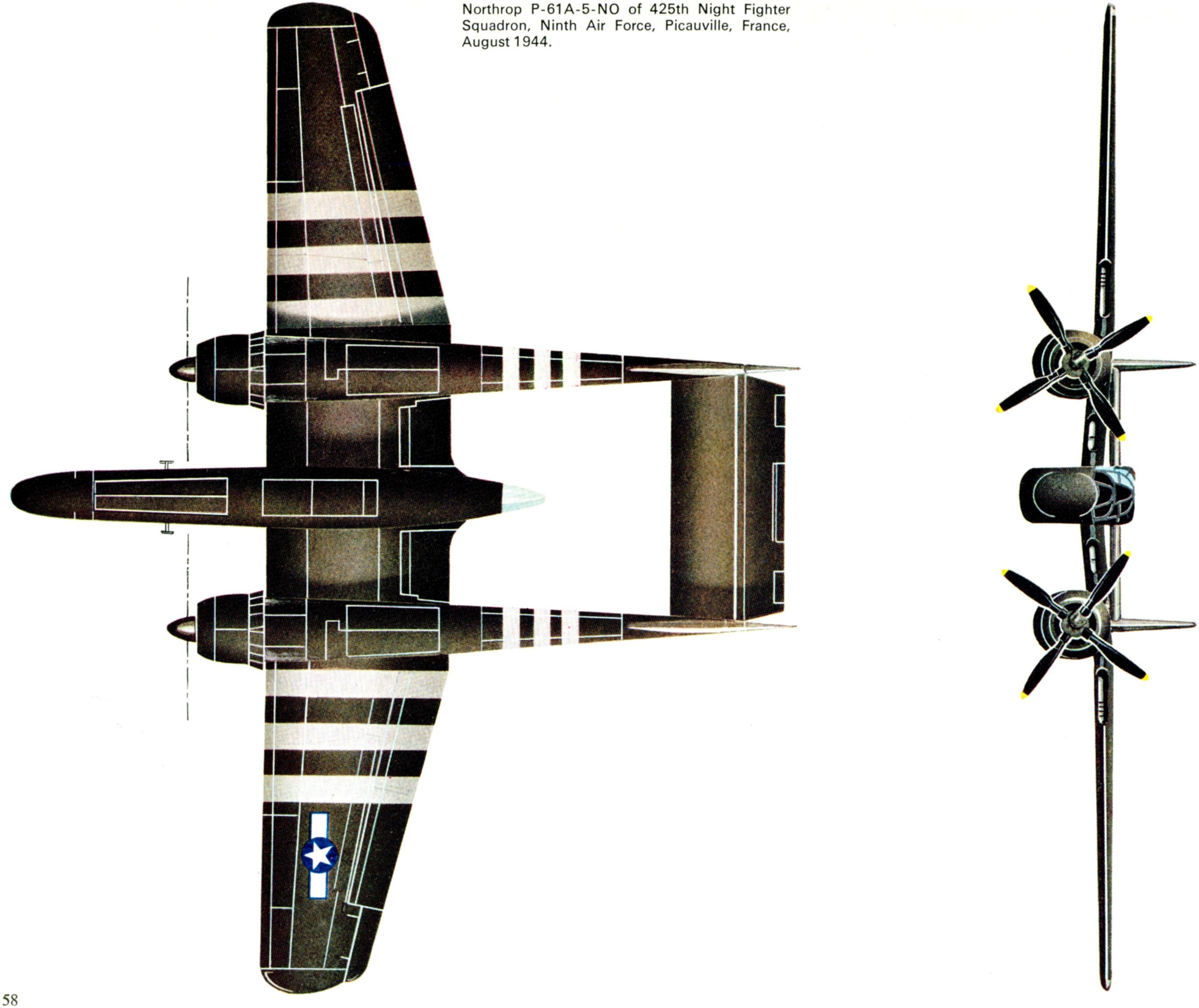

BATTLE "AX"
BATTLE "AX"

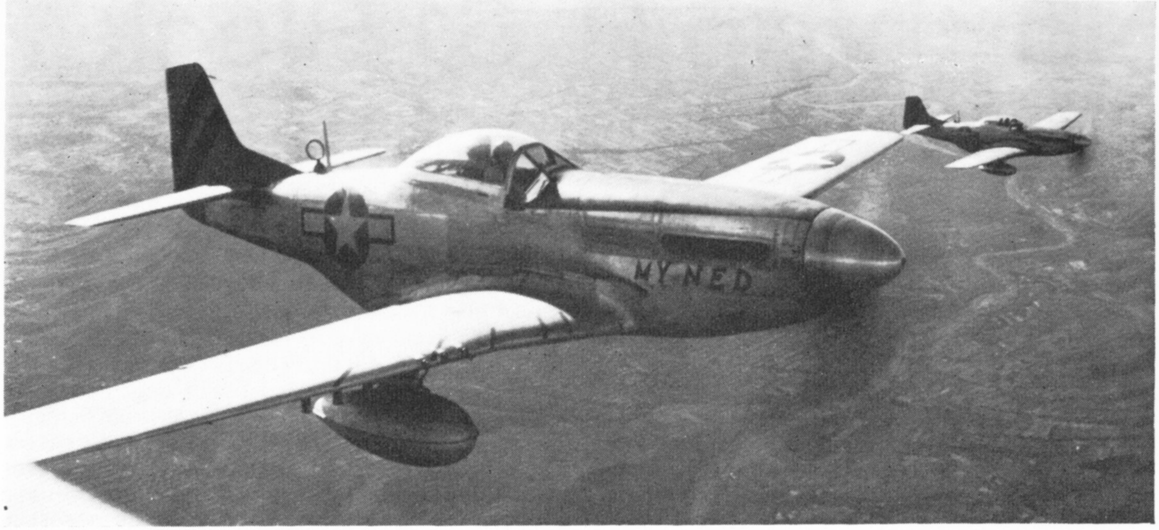
Northrop P-61A-5-NO of 425th Night Fighter Squadron, Ninth Air Force, Picauville, France, August 1944.

The remaining views will be found overleaf.

© D. Nicholas

Northrop P-61A-5-NO of 425th Night Fighter Squadron, Ninth Air Force, Picauville, France, August 1944.





P-51Ks, 'My Ned' nearest camera, of the 311th Fighter Group. [*U.S.A.F., via Francillon.*

was not immediately evident but was noted by pilots with combat experience in the Republic P-47 Thunderbolt. The Mustang's liquid-cooled engine was more prone to battle damage than the big radial power plant of the P-47, and its airframe did not have the same capacity as that of the 'Jug' to absorb combat punishment. These were, indeed, comparatively minor faults and the Mustang will be remembered as the best land-based U.S. fighter aircraft of the Second World War.

SERVICE DEPLOYMENT OF THE MUSTANG

ARMY AIR FORCES

Northern Europe

Eighth Air Force

4th Fighter Group (March 1944); 20th Fighter Group (July 1944); 55th Fighter Group (July 1944); 78th Fighter Group (Dec. 1944); 339th Fighter Group (April 1944); 352nd Fighter Group (April 1944); 353rd Fighter Group (Oct. 1944); 355th Fighter Group (April 1944); 356th Fighter Group (Nov. 1944); 357th Fighter Group (Feb. 1944); 359th Fighter Group (April 1944); 361st Fighter Group (May 1944); 364th Fighter Group (July 1944); 479th Fighter Group (Sep. 1944); 7th Photographic Group (Recon.) (1945).

Ninth Air Force

354th Fighter Group (Dec. 1943); 363rd Fighter Group (Jan. 1944); 370th Fighter Group (March 1945); *10th Photographic Group (June 1944); *67th Tactical Reconnaissance Group (Jan. 1944); *363rd Tactical Reconnaissance Group (Sep. 1944).

Italy

Twelfth Air Force

**27th Fighter-Bomber Group (June 1943); **86th Fighter-Bomber Group (July 1943); *68th Reconnaissance Group (Nov. 1942).

Fifteenth Air Force

31st Fighter Group (April 1944); 52nd Fighter Group (April 1944); 325th Fighter Group (May 1944); 332nd Fighter Group (June 1944).

Central Pacific

Seventh Air Force

21st Fighter Group (Jan. 1945).

South-West Pacific

Fifth Air Force

3rd Air Commando Group (Dec. 1944); 35th Fighter Group (March 1945); 348th Fighter Group (1945); *71st Reconnaissance Group (Nov. 1944).

West Pacific

Twentieth Air Force

15th Fighter Group (Feb. 1945); 21st Fighter Group (Feb. 1945); 506th Fighter Group (May 1945).

C.B.I.

Tenth Air Force

**311th Fighter-Bomber Group (Sep. 1943); 311th Fighter Group (1944); *8th Reconnaissance Group (April 1944).

Fourteenth Air Force

23rd Fighter Group (Aug. 1944); 51st Fighter Group (1945).

Independent units

1st Air Commando Group (March 1944); 2nd Air Commando Group (Nov. 1944).

Notes: Dates in parentheses refer to first operation with Mustangs.

*Indicates groups equipped with F-6s reconnaissance aircraft.

**Indicates groups equipped with A-36As dive-bomber aircraft.

Specification	XP-51	P-51A	P-51C	P-51D	P-51H	XP-51J
Span, ft. in.	37 0	37 0	37 0	37 0	37 0	37 0
Length, ft. in.	32 3	32 3	32 3	32 3	33 4	32 11
Height, ft. in.	12 2	12 2	13 8	13 8	13 8	13 8
Wing area, sq. ft.	233	233	233	233	233	233
Empty weight, lb.	6,278	6,433	6,985	7,125	6,585	6,030
Loaded weight, lb.	7,965	8,600	9,800	10,100	9,500	7,550
Maximum weight, lb.	8,400	9,000	11,800	11,600	11,054	9,140
Wing loading, lb./sq. ft.	34.2	36.9	42.1	43.3	40.8	32.4
Power loading, lb./h.p.	6.9	7.2	6.7	6.8	6.9	5.0
Maximum speed, m.p.h./ft.	382/13,000	390/20,000	439/25,000	437/25,000	487/25,000	491/27,400
Cruise speed, m.p.h./ft.	300	307	362	362	380	—
Climb rate, ft./min.	20,000/10.9	20,000/9.1	20,000/6.9	20,000/7.3	20,000/7.5	20,000/5
Service ceiling, ft.	30,800	31,350	41,900	41,900	41,600	43,700
Normal range, miles	625	350	400	950	850	—
Maximum range, miles	1,040	2,550	2,700	2,300	2,400	—
Power plant	V-1710-39	V-1710-81	V-1650-7	V-1650-7	V-1650-9	V-1710-119
T.O. rating, h.p.	1,150	1,200	1,490	1,490	1,380	1,500
Maximum rating, h.p./ft.	1,150/11,800	1,470/11,800	1,720/17,000	1,720/6,200	2,220/10,200	1,720/20,700
Armament	4×0.50 in. 4×0.30 in.	4×0.50 in. 1,000-lb. bomb	4×0.50 in. 1,000-lb. bomb	6×0.50 in. 2,000-lb. bomb	6×0.50 in. 2,000-lb. bomb	4×0.50 in.

Northrop P-61 Black Widow

'Black Widow, the female of an American variety of spider, having a glossy black body with reddish markings underneath, and a very poisonous bite; so-called because it eats its mate' (*Webster's New World Dictionary of the American Language*, College Edition). Like its namesake of the arachnid family the Northrop P-61 had, at least in most instances, a glossy black body with reddish markings (serial numbers) and a very poisonous bite (four 20-mm. cannons and four 0.50-in. machine-guns). But, whereas the spider is noted for its small size the aeroplane is remembered as the largest operational American fighter aircraft of the Second World War. It is also believed the designers did not intend for their aircraft that it would eat its mate. . . .

The second YP-61 (41-18877) with dummy dorsal turret. Note exhaust pattern. [*Northrop, via Francillon.*

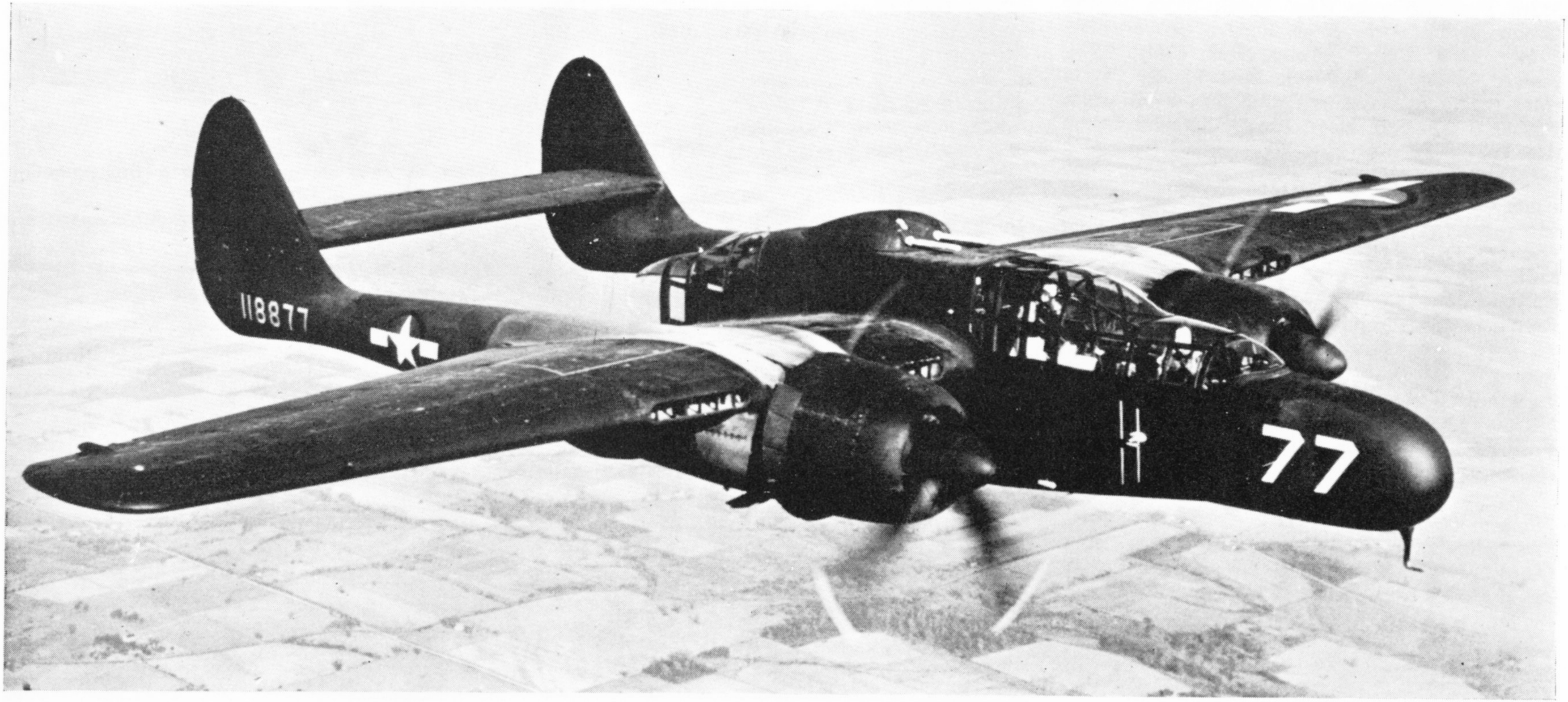
Design history

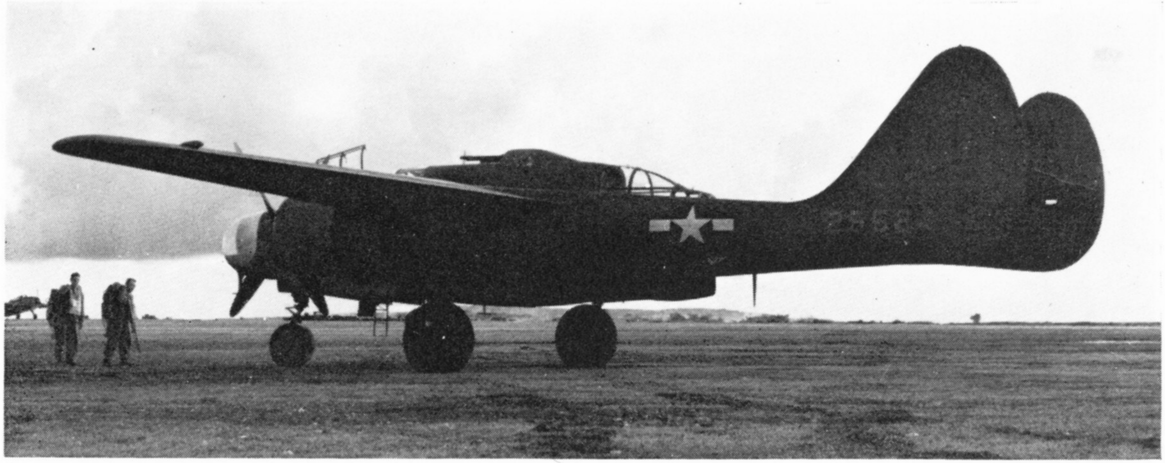
The night Blitz which followed the Battle of Britain in the autumn of 1940 alarmed a number of high-ranking American officers, who realised that if the Army Air Corps did not have in service fighter aircraft comparable to the Spitfire and BF 109, they were in an even worse shape as far as night fighting aeroplanes were concerned. Little time was wasted in initiating the development of a new aircraft large enough to carry the still bulky radar equipment then under development, and heavy armament. On November 6 1940—two weeks after preliminary information were submitted to his company—John K. Northrop, President of Northrop Aircraft Inc., went to Wright Field with his first proposal.

In the first drawings the aircraft was characterised by low-slung engine nacelles tapering back into twin tail-booms which were joined by a horizontal stabiliser and elevator. The long fuselage, projecting fore and aft of the inner wing panels, housed the armament and crew. Remotely controlled turrets, each housing four 0.50-in. machine-guns and rotating through a 230° spherical range, were to be installed in the nose and tail of the central nacelle, and crew consisted of a pilot and two gunners.

By November 14 crew had been increased to four and armament now consisted of four 0.50-in. machine-guns in a dorsal turret and a ventral turret with two similar weapons. The basic design was finalised on November 22 1940, crew being again reduced to three and the lower turret being eliminated, whilst four 20-mm. cannons were to be installed in the wings.

The importance of this aircraft can be gauged by the quick succession of events which followed the submission of the proposal:





An early P-61A, with dorsal turret, photographed on Saipan on July 5 1944. [*U.S.A.F., via Francillon.*

Dec. 17 1940: price quotation for two prototypes submitted.

Jan. 11 1941: contract signed by Northrop Aircraft Inc.

Jan. 30 1941: contract approved by Under-Secretary of War. Two XP-61 prototypes ordered.

Mar. 10 1941: contract for 13 YP-61 service test aircraft.

Sep. 1 1941: first production contract calling for 150 P-61s.

Feb. 26 1942: follow-on production contract calling for 410 additional aircraft.

Whilst having received contracts covering a total of 575 prototypes and production aircraft, Northrop Aircraft Inc. had yet to fly the first XP-61 and were busily refining the design of the aircraft. Major changes incorporated during this time-period included the relocation of the 20-mm. cannons into a ventral tray, substitution of Western Electric radar equipment for the M.I.T. unit originally specified, and the addition of exhaust dampers and armour protection.

Finally, on May 21 1942, the natural metal finished XP-61 (41-19509) made its first flight with test pilot Vance Breese at the controls. Powered by two Pratt & Whitney R-2800-10 eighteen-cylinder radials driving Hamilton Standard propellers (the intended Curtiss Electric units not being yet available), the aircraft was fitted with a mock-up turret because of late delivery of the General Electric turret. At the end of the 15-minute maiden flight Vance Breese enthusiastically told John K. Northrop: 'Jack, you've got a damn fine airplane.' Yet a number of modifications had to be introduced and included a change in horizontal tail surfaces to improve longitudinal stability. Shortly afterward the entire trailing edge of the wing was rebuilt to incorporate full span flaps and retractable ailerons. All these modifications were incorporated in the second XP-61 (41-19510) during its construction and this aircraft flew for the first time on November 18 1942. Further minor modifications were introduced progressively, and on April 15 1943 the second XP-61 was delivered to the Army Air Forces at Wright Field, where it was followed within a month by the first prototype.

Black Widow development

As already mentioned no less than 575 aircraft had been ordered prior to the first flight of the XP-61, and, as flight trials proved successful, production got underway rapidly, despite the fact that Northrop had to take over from their prime sub-contractors, Briggs Manufacturing Co., the construction of inner wings.

YP-61: Thirteen service test aircraft (41-18876 to 41-18888). Minor internal modifications. Delivered in August and September 1943.

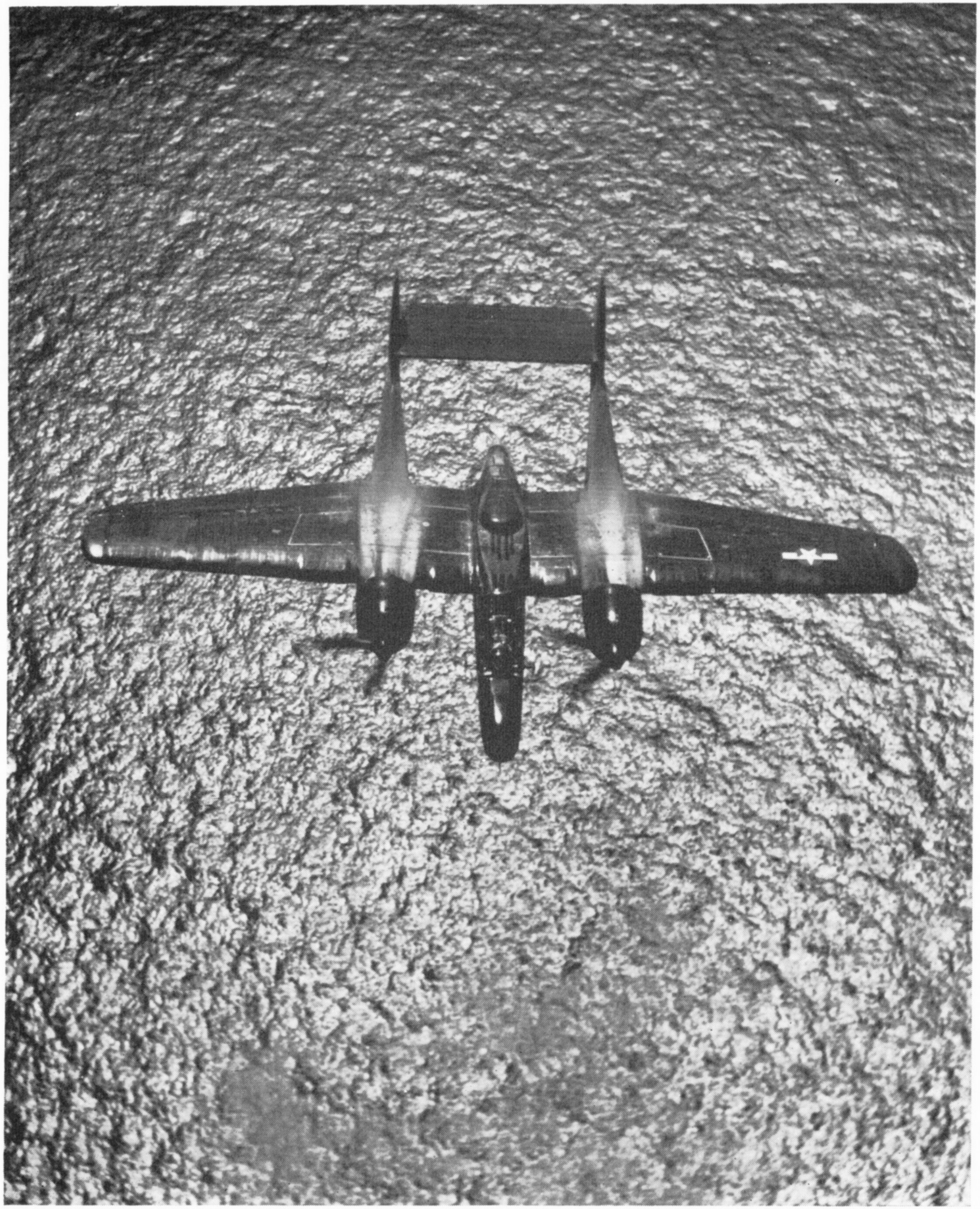
P-61A: First production model of which 200 were built (42-5485 to 42-5634 and 42-39348 to 42-39397). The first 37 aircraft were powered by a pair of R-2800-10 radials and carried the same armament as the test aircraft; the next eight aircraft had identical engines but no dorsal turret, whilst the last 155 aircraft were powered by two R-2800-65 engines and had no dorsal turret. Late production aircraft were fitted with wing racks for either two 300 U.S. gallon drop-tanks or two 1,600-lb. bombs. Removal of the dorsal four-gun turret was dictated by excessive tail buffeting problems.

P-61B: Major production model of which 450 were built (42-39398 to 42-39757 and 43-8231 to 43-8320). In this series also several changes were introduced during production. The dorsal turret was omitted on the first 200 aircraft and reintroduced on the last 250 aircraft (the last block, P-61B-20, featured an improved fire control system for its turret). The P-61B-1 to P-61B-5 carried either two drop-tanks or two bombs, whilst the P-61B-10 to P-61B-20 had four racks—one inboard and one outboard of each boom—to carry either four 300 U.S. gallon tanks or two of these tanks and two bombs.

P-61C: Final production version of which 41 were built (43-8321 to 43-8361). Airframe and armament similar to those of the P-61B-20. Two turbo-supercharged R-2800-73, boosting maximum speed to 430 m.p.h. at 30,000 ft. Retractable dive brakes above and below outer wing panels.

XP-61D: Modification of two P-61As (one of which

'Swing Shift Skipper', the P-61A of Major Carrol Smith, C.O. of the 547th Night Fighter Squadron. Two victory markings under cockpit. [*U.S.A.F., via Francillon.*



Black Widow prowling in the Marianas, summer of 1944. [U.S.A.F., via Francillon.

was 42-5559) with turbo-supercharged R-2800-77 engines.

XP-61E: Two experimental two-seat long-range day-fighters. Modified from P-61A airframes (including 42-39549) with R-2800-65 engines. Crew of two under bubble canopy. No dorsal turret and forward-firing 20-mm. cannons supplemented by four fixed 0.50-in. machine-guns installed in the nose in place of radar equipment.

XP-61F: Projected modification of one P-61C (43-8338). Not realised.

P-61G: Projected version cancelled at end of war.

XF-15: Modified XP-61E serving as prototype for F-15 reconnaissance aircraft.

XF-15A: Similar modification of one P-61A.

F-15A: Production version of the reconnaissance aircraft named Reporter, of which 36 were built in 1946 (45-59300 to 45-59335). R-2800-73 engines giving a top speed of 440 m.p.h. Redesignated RF-61C in 1948.

F2T-1: Designation of twelve surplus P-61As acquired in 1945 by the U.S. Marine Corps to serve as night-fighter trainers. BuNos. 52750 to 52761.

Service history

During service tests in 1943 three aircraft were used in a series of tests at Fort Barrancas, Florida, to determine what colour would give the least possible refraction and therefore be extremely difficult to locate in the beam of a searchlight. One aircraft was left in natural metal finish, one was painted olive drab overall and the third was finished in glossy black overall. Sent through the searchlight beams in this order the three aircraft went through their tests. It is said that after spotting the first two aircraft and waiting for the third —the all-black ship—an observer picked up a phone irately: 'Hey, when are you guys going to send over that third plane?' He was assured that this aircraft had flown through the beams, and so the P-61s started coming from the factory with a shiny, jet black coat of paint and red serial numbers. Quickly the workers began calling the aircraft 'Black Widow' and the name stuck. It was adopted by the War Department as part of the official designation.

The Black Widow made its service début almost simultaneously in the Pacific and European theatres of operations during the early summer of 1944. In the E.T.O. the P-61s were operated by the 422nd and 425th Night Fighter Squadrons of the Ninth Air Forces. These two units took delivery of their first P-61As in

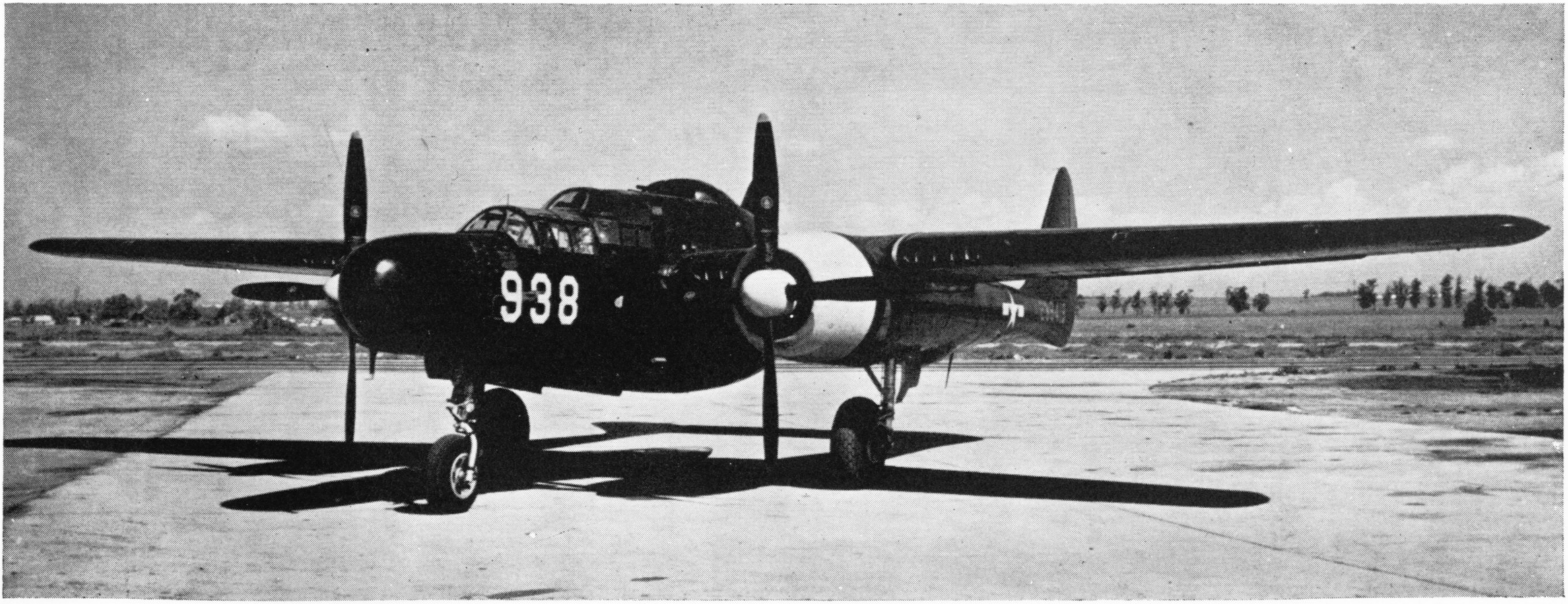
May 1944 and were subsequently used in offensive and defensive missions, striking at enemy mechanised convoys, troop columns, supplies and aircraft. They ranged into Germany at night and struck down enemy raiders over Allied lines. According to a report published during the war by the *Boston Globe*, the first P-61 victory in Europe was credited to Lt Raymond A. Anderson and, later, Lt Paul A. Smith became the first Black Widow ace in that theatre. However, only a small number of P-61s were available and maintenance problems with their radar equipment limited further their operations, whilst upon firing their cannons they often experienced accidental nose-wheel drop. Yet for their participation in the Battle of the Bulge the 422nd Night Fighter Squadron won a Distinguished Unit Citation. Other targets for the P-61s included German V-1 buzz-bombs, and the Black Widow proved quite effective at night against these weapons.

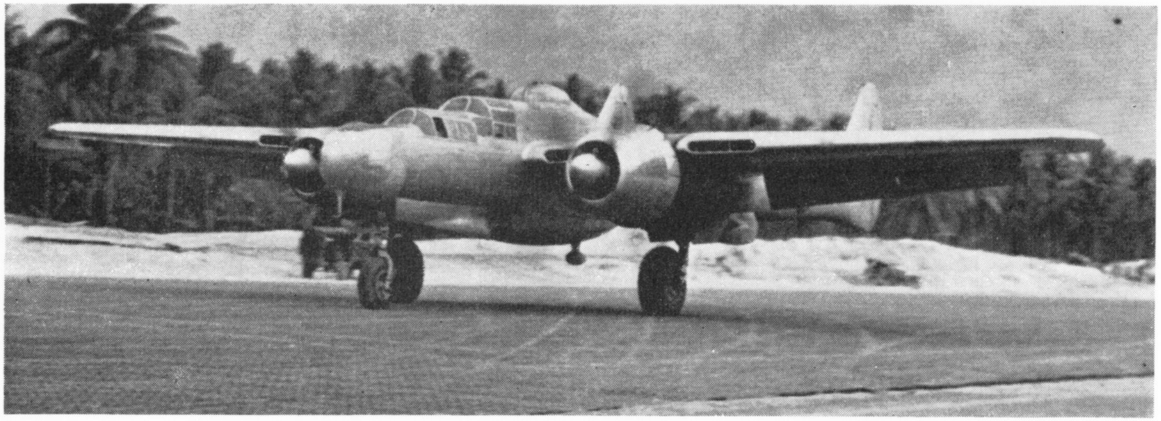
In the Pacific, although flown in combat by only four squadrons—including the 419th and 547th Night Fighter Squadrons—the Black Widows operated over Guadalcanal, New Guinea, the Philippines and the Marianas. Upon their arrival in the theatre the P-61As were received with scepticism by their pilots, who doubted that a fighter aircraft as big as a medium bomber could be sufficiently manœuvrable or speedy enough for combat operations. Fortunately Northrop's test pilot, John Myers—who had done most of the development flying—had been sent with the first aircraft to demonstrate the Black Widow's surprising potential. Soon the pilots gained confidence and on July 7 1944 they obtained the first P-61's kill in the South Pacific.

During the Philippines campaign Japanese aircraft, denied air superiority in daylight operations, resorted to their old tactics: night harassment by small groups of aircraft. Now at last the Army Air Forces possessed in the Black Widow an aircraft capable of effectively countering this nuisance, and the P-61 became known to American ground forces as the 'South Pacific Sandman' for its success in driving off Japanese night-raiders. During these operations Major Carroll C. Smith, of the 547th Night Fighter Squadron, became the first Black Widow ace in the Pacific, by knocking down over Mindoro four Japanese aircraft in a single night, bringing his total score to seven. The Black Widows were also quite successful over Saipan, where they protected the B-29 airfields from fanatical Japanese night-bombing attack.

Specification	XP-61	P-61B	XP-61D
Span, ft. in.	66 0	66 0	66 0
Length, ft. in.	48 11	49 7	48 11
Height, ft. in.	14 8	14 8	14 8
Wing area, sq. ft.	663	664	664
Empty weight, lb.	19,245	22,000	23,205
Loaded weight, lb.	25,150	29,700	29,850
Maximum weight, lb.	28,870	38,000	39,715
Wing loading, lb./sq. ft.	37.9	44.7	46.1
Power loading, lb./h.p.	6.2	7.4	7.1
Maximum speed, m.p.h./ft.	370/20,900	366/20,000	430/30,000
Cruise speed, m.p.h./ft.	200	200	310
Climb rate, ft./min.	20,000/9	20,000/12	30,000/13.5
Service ceiling, ft.	33,100	33,100	43,000
Normal range, miles	1,200	1,010	1,050
Maximum range, miles	1,450	1,900	1,900
Power plant	2× R-2800-10	2× R-2800-65	2× R-2800-77
T.O. rating, h.p.	2,000	2,000	2,100
Maximum rating, h.p./ft.	2,000/16,900	2,040/21,000	2,800/30,000
Armament	4× 20 mm. 4× 0.50 in.	4× 20 mm. 4× 0.50 in. 4,000-lb. bomb	4× 20 mm. 4× 0.50 in. 4,000-lb. bomb

Factory photograph of the P-61B (42-39419). The dorsal turret was dispensed with, but was later refitted on the 201st P-61B. [*Northrop, via Francillon.*



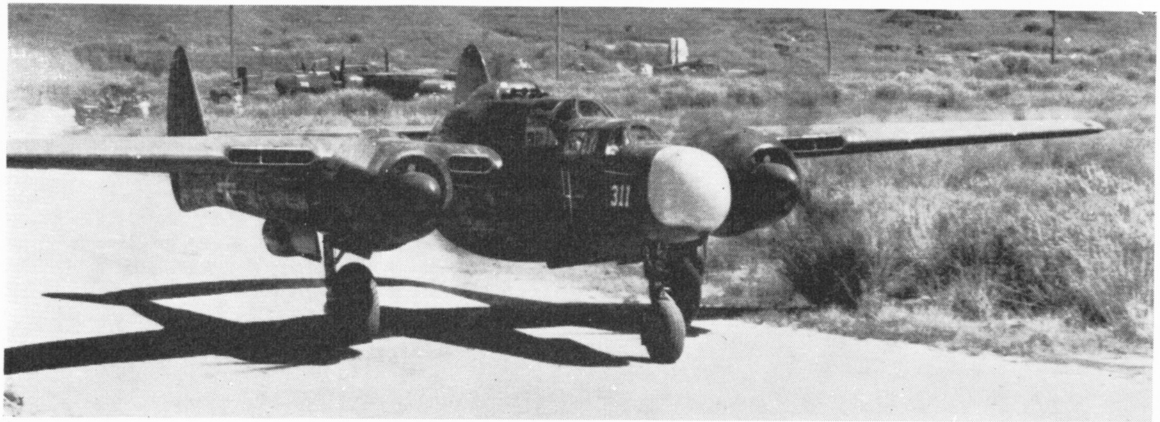


An unarmed and unpainted P-61A flown by Brig-Gen Earl Barnes, landing on the airfield on Middleburg Island, off New Guinea. [U.S.A.F., via Francillon.

The Black Widow evaluated

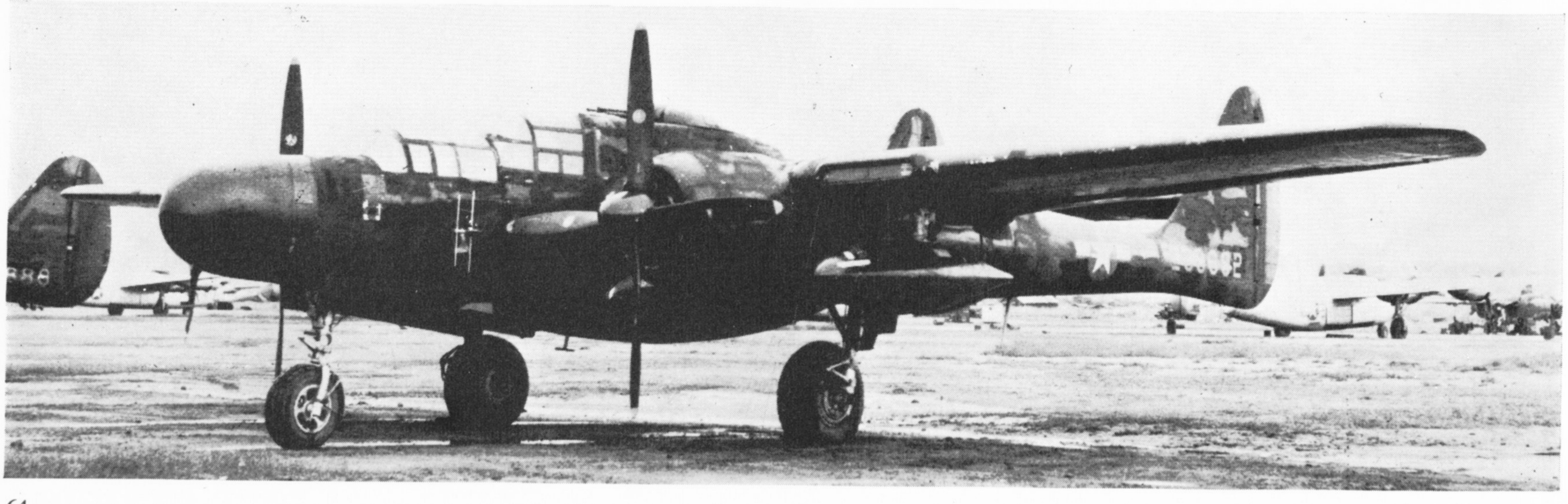
Conceived at a time when effective night-fighting tactics had yet to be evolved and when radar equipment then under development were large and heavy, the P-61 was unusually large for a fighter aircraft. Yet due to the use of full-span flaps and dropping ailerons the Black Widow was exceptionally manœuvrable for its size. Another positive factor in its favour was its potent armament, a feature of considerable importance when one considers that in night combat the pilot had often only one chance to get into good firing position.

However, radar development made quick progress and by 1944 smaller and lighter sets were available and were installed on smaller aircraft such as the Lockheed P-38M and the Grumman F6F-5N (a Marine Corps unit flying Hellcats did replace in the Philippines the 547th Night Fighter Squadron and their P-61s). Furthermore the P-61s combat career was plagued by radar failures and difficulties with the hydraulic system. Yet the aircraft remained until 1950 the only night-fighter aircraft available in substantial numbers to the Army Air Forces and, later, to the U.S.A.F.



Left: Major Baker, C.O. of the 419th Night Fighter Squadron, taxying his P-61A on an airfield at Guadalcanal. [U.S.A.F., via Francillon.

Below: P-61B-10-NO with four under-wing tanks photographed at Clark Field, Philippines, in August 1945. [U.S.A.F., via Francillon.



Men and Machines Series

An authoritative series of the World War II combatants which will eventually span the American, British, French, German, Japanese and Russian fighting aircraft.

Contents of the first nine titles include:

1 **American Fighters,** Volume One
Contains the history of the P-51 Mustang and has four five-view drawings of this historic aircraft. Bell P-39 Airacobra, Boeing P-26, Grumman F4F Wildcat, Grumman F6F Hellcat, Lockheed P-38 Lightning, North American P-51 Mustang, Northrop P-61 Black Widow.

2 **German Air Force Fighters,** Volume One
A complete history of the Messerschmitt Fighters from the Piston-engined Bf 109 to the first operational German jet propelled Fighter—the Me 262. Messerschmitt Bf 109, Messerschmitt Bf 110, Messerschmitt Me 210, Messerschmitt Me 410, Messerschmitt Me 163, Messerschmitt Me 262, Luftwaffe Unit Insignia.

3 **RAF Bombers,** Volume One
Tells the complete development history of the Avro Lancaster and Manchester and the de Havilland Mosquito. Avro Lancaster, Avro Manchester, Consolidated B-24 Liberator, de Havilland Mosquito, Douglas Boston, Fairey Battle.

4 **German Air Force Bombers,** Volume One
Details the history of the four major Bombing Aircraft of the Luftwaffe—Dornier Do 17, Heinkel He 111, Junkers Ju 88, Focke-Wulf FW 200 Condor.

5 **RAF Bombers,** Volume Two
Highlights the story of the famous Handley Page Halifax—second of the R.A.F.'s four-engined "heavies". Boeing B-17C Fortress I, Blenheim, Handley Page Hampden, Handley Page Halifax, Lockheed Vega Ventura, Vickers Wellesley.

6 **Japanese Navy Bombers**
Development of Naval Aviation in Japan. Carrier-Borne Torpedo and Dive Bombers, Land-Based Bombers, Technical Appendix, Aichi D3A1–2, Mitsubishi G3M1–3, Mitsubishi G4M1–3, Nakajima B5N2–B6N2, Yokusaka D4Y1–4.

7 **German Air Force Fighters,** Volume Two
Covers, in detail, the Focke-Wulf Fw 190. Focke-Wulf Fw 190, Dornier Night Fighters, Heinkel He 100, Heinkel He 162, Heinkel He 219, Junkers Ju 88 Fighters, Camouflage and Markings.

8 **RAF Fighters,** Volume One
Presents detailed history and six coloured drawings of the various marks of the Supermarine Spitfire, Bell P-39 Airacobra, Gloster Gladiator, Gloster Meteor, North American P-51 Mustang, Supermarine Spitfire, Westland Whirlwind.

9 **German Air Force Bombers,** Volume Two
Concentrates on the detailed development of the Heinkel He 177. Arado Ar 234, Dornier 217, Heinkel He 177 Griffon, Junkers Ju 188, The Mistletoe.

The next three books in preparation for this series are:

10 **American Fighters,** Volume Two
11 **French Fighters**
12 **American Bombers,** Volume One

Hylton Lacy Publishers Ltd

Coburg House, Sheet Street, Windsor, Berkshire, England

Printed in England